The Amman Governorate Water Authority Water and Wastewater Cost/Tariff Models

User's Manual

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FORWARD

Collaborative Approaches for Resolving Water Issue

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CHAPTER ONE
BACKGROUND

The United States Agency for International Development (USAID) and the Ministry of Water and Irrigation (MWI) have provided joint-funding support to the Fostering Resolution of Water Resources Disputes Project (FORWARD) to develop computer models to assist the Water Authority of Jordan (WAJ) in its future financial planning for water and wastewater service to the municipal and industrial sectors in the Governorate of Amman. In Amman, water and wastewater services are provided by the Amman Governorate Water Authority (AGWA) which is part of WAJ.

In August 1997, the FORWARD team commenced detailed work on the development of two electronic spreadsheet models for WAJ, one for the water utility (AGWA-W) and a separate, but linked model for Amman wastewater utility (AGWA-WW). In December 1997 draft versions of the two models were provided to WAJ for review. After model revisions and a training/transfer period, final versions of the models were provided to WAJ for use in February 1998.

The AGWA-W and AGWA-WW models were designed to be easy to understand and use. Each model comprises one workbook, and each model is subdivided into logical planning, engineering, and financial components which are assigned to one or more worksheets (pages) of the workbook. Data links exist between individual components (worksheets) within each model and between the two models (workbooks).

The models have standard cost accounts and model parameters for each cost center and the tables for each center have a similar structure and format to allow for grouping of individual worksheets for common editing (adding rows, changing labels or formulas) of all selected sheets at one time. This has facilitated the development of the model. Cost centers have been defined in coordination with WAJ to identify the cost of water at the individual major sources, facilities, and transfer points, and include sources, wastewater treatment plants, pump stations, and networks.

The last worksheets of each model are various schematics outlining the conceptual structure of the cost centers and transaction points and providing a pattern of the data flow and links in the models.

1.1 Model Goals, Capabilities, and Limitations

The primary goal in developing the two models was to give WAJ the ability to examine a wide array of potential future financial scenarios, given underlying changes in key system parameters, and to see the effect of such changes upon projected annual utility costs and needed revenue recovery. Besides their

planning purposes, the water and wastewater models were also to be used in annual utility budgeting and tariff setting.

The AGWA-W and AGWA-WW models meet these goals and should provide the Authority with a flexible and powerful tool for near- and long-term utility planning. However, because of their focus on aggregated costs revenue needs and the need to keep the model size manageable, the two models do have limitations in their assessment capability. The AGWA-W and AGWA-WW models are not detailed systems operations models or detailed accounting programs suitable for monthly cash flow management. Their focus is annual and at a level of detail suitable for forecasting major expenses and revenues.

A glossary of commonly-used terms is provided in Annex A and a schematic of the transition and terminology of some important water planning concepts appears in Figure 1. It would be best to review these prior to reading the technical chapters.

1.2 Modeling Software and System Requirements

The two models were developed using the Microsoft Excel 7.0 3-D electronic spreadsheet software. This modern software allowed each model to be developed in easy-to-understand logical planning and financial modules assigned to individual worksheets (pages) of a workbook. Because of similarity in the cost-accounting structure, this 3-D layering of similarly-designed pages facilitated model creation and editing as well as allowing for the addition or deletion of new cost centers as the need arises over time. Most importantly, the use of the electronic spreadsheet tool greatly facilitates the conduct of what-if analyses that are critical in evaluating future courses of action.

Since the current version of the models is several megabytes in size, software (such as pkzip and pkunzip) that allows the zipping and un-zipping of large files is recommended for easier file transfer.

The minimum hardware system requirement recommended for the models' operation is a PC with at least 150 MHz Pentium processor, 32 Mb RAM with 256K cache, 2-4 Mb video RAM, 2.0 Mb or greater hard disk, 10X or higher CD-ROM, and a 3.5" diskette drive. A color desk-jet printer for the printing of informative colored tables and charts from the models is also recommended.

CHAPTER TWO
JORDAN VALLEY AUTHORITY MODEL

2.1 Overview

At its simplest level, the AGWA-W model contains four major analytical components or processes that represent either a single worksheet or groups of worksheets:

- **Financial/Model Parameters Component**

  Contains the model's summary financial information in tabular and graphical form as well as global model parameters that, when changed, can have widespread effects on the model's calculations and results.

- **Planning Component**

  Contains the various underlying factors and calculations affecting system growth, water demand, water supply availability, and how water supplies are allocated in either surplus or deficit conditions.

- **Revenue Component**

  Contains the calculations that generate system subscriber revenues and fees as well as adjustments to revenues.

- **Cost Component**

  Contains the various cost centers of the utility, the local parameters that uniquely affect their expenses, the calculation of costs, and various aggregations of cost centers used for tariff considerations.

The underlying details of the AGWA-W model are somewhat more complicated with a larger number of sub-components addressing various planning, engineering or financial issues and data flowing from one portion of the model to another. Figure 1 illustrates a general flow chart of the logic of the water model and the major flow of data between its sub-components.

While input parameters affecting the calculations are present throughout, the model essentially begins with demographic/economic growth and customer issues giving rise to projected customer water demand. Physical water losses of the system are accounted for to derive the total demand which is compared to available water supplies, and decisions are made on how to ration supplies during shortages or how to allocate or draw upon various supplies during surplus conditions. The quantity of water pumped is derived from these decisions.

These decisions are used as key inputs to determine the expenses of various cost centers. These cost data are then aggregated for financial analyses.

Expected system income is generated from customer counts and usage data multiplied by the applicable tariffs and fees schedules and then adjusted for billing collections. This expected income is compared with expenses, resulting in the net income of the system. Management decisions can then change variables underlying income or expenses to see the affect on desired performance goals.

Water Model Components and Worksheets

Financial/Model Parameters Component	
AGW IS	Water and Wastewater Utilities Combined Income Statement
WatIS	Water Utility Income Statement and Global Parameters
Planning Component	
WatDem	Total Water Subscribers and Demand by Customer Class
WatBal	Water Demand and Supply Balance
Revenue Component	
WatRev	Water Income
Cost Component	
Perf. Ind	Water Expenses – Performance Indicators
Cost Summary	Water Expenses
WatExp	Water Expenses
WatExp w/o Tankers	Water Expenses without tankers
WatExp-Sources	Water Expenses – Sources
Deir Alla-Tomato	Water Expenses – Deir Alla supply to Tomato Factory
Deir Alla-Balqa&Amman	Water Expenses – Deir Alla supply to Salt and Amman
Fuhais-Amman	Water Expenses – Fuhais supply to Amman
Wala-Muntazeh	Water Expenses – Wala supply to Muntazeh
Khaw-Amman	Water Expenses – Khaw supply to Amman
Qatraneh	Water Expenses – Qatraneh supply to Amman
Swaqa-Amman	Water Expenses – Swaqa supply to Amman
Qastal-Amman	Water Expenses – Qastal supply to Amman
Ain Ghazal-Amman	Water Expenses – Ain Ghazal supply to Amman
Nafaq-Amman	Water Expenses – Nafaq supply to Amman
Erenbeh-Amman	Water Expenses – Erenbeh supply to Amman
Musitbeh-Amman	Water Expenses – Musitbeh supply to Madaba and Amman
Disi-Amman	Water Expenses – Disi supply to Amman

Pumping Stations & Network	Water Expenses – Amman Pumping Stations and Network
Distr&CustAdmin	Water Expenses – Amman Distribution and Customer Administration
Tankers	Water Expenses – Tankers
G&A Water	General and Administrative Expenses – Amman Water
G&A (w/o Tankers)	General and Administrative Expenses – Amman Water without Tankers
G&A (AGWA)	General and Administrative Expenses – Water and Wastewater
G&A (WAJ)	General and Administrative Expenses – Water and Wastewater (WAJ Share)
Others	
TP W (2)	Summary of Salaries and Social Security – All Sources
Sal Allocation	AGWA Salaries
Schematic	AGWA Schematic Diagram
Model Flow	Flow of Data among Model Sheets
Rev Flow	Flow of Data among Revenue Sheets
Cost Centers Diagram	AGWA Water Data Input Requirements for Calculating Expenses – Cost Centers.
G&A Diagram	AGWA Water Data Input Requirements for Calculating Expenses – General and Administrative Expenses

2.2 Financial Summary and Global Model Parameter Component

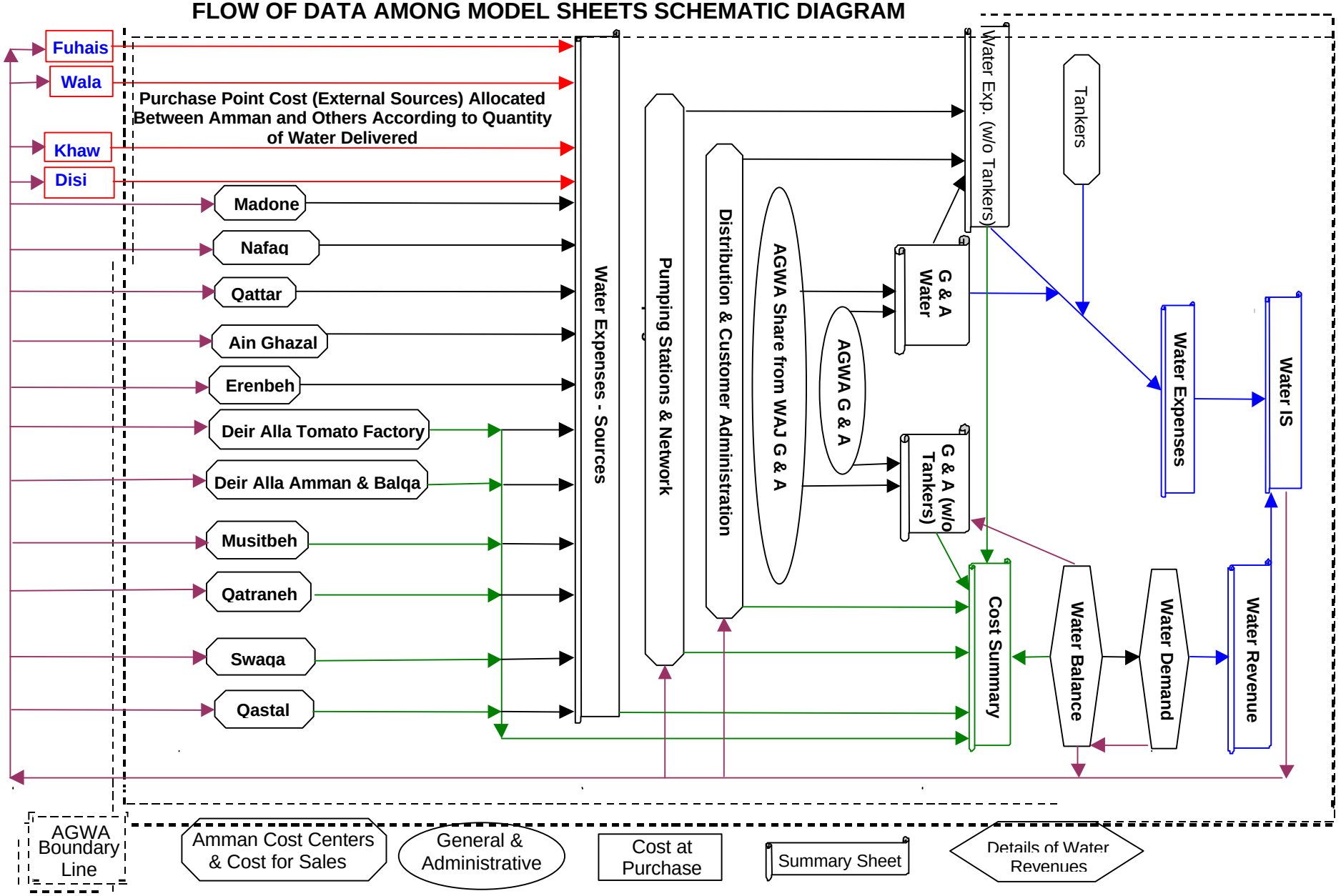
This component contains the summary financial performance of the utility (income statements), various performance measures, and global parameters that affect large portions of the model when changed by the user. For the most part, this component contains the main drivers of the model (global parameters) as well as the results (income statement and performance measures). These beginning and ending pieces are packaged together to allow the model operator to perform what-if change scenarios on the parameters and quickly see the overall results of the changes.

Income Statements Worksheet

This component of the model, being summary and/or input data in nature, resides on a single sheet, **WatIS.**

FIGURE 1

FLOW OF DATA AMONG MODEL SHEETS SCHEMATIC DIAGRAM



Net Income Table

The first table represents the highest level of information in the model. In effect, any significant change to the model's parameters is reflected in changes to the financial data in this table. Much of the data for this table are obtained from the underlying worksheets that summarize the revenue and costs of the water utility, and are simply passed to the net income table for presentation and subsequent calculation of the utility's net income.

Three different levels of net income are calculated: net income after operating expenses, net income after operating and interest expenses, and net income after operating, interest, and principle expenses (full cost recovery). These three performance levels are also provided as percentages.

This last item (percent of revenue recovery goals) is most useful in specifying alternative tariff schedules and ascertaining the change in revenue's impact on the targeted revenue recovery goal.

Graphs

Below the net income table are various informative graphs on the utility's performance that will assist the model operator and decision-makers in interpreting the model's results.

Global Parameters Tables

Below these graphs are various tables identifying the model's global parameters. Tables for various user-specified data on common costs (such as costs for electricity and fuel), inflation rates, growth rates, per capita use rates, efficiency rates, tariff levels, and other parameter data are specified. Changes in the variable will affect multiple underlying worksheets and have a more noticeable effect upon the utility's financial performance.

The historical data for these parameters, shown for the first few years, can be used as an initial starting basis for the user-specified projected values. Projected changes from the historical value or trend for future years can then be made based upon known effects of planned projects, new negotiated prices, information received from other ministries or agencies, desired policy targets, or best professional guesses of staff.

The model has been structured to allow for separate residential, institutional, commercial, and industrial tariff schedules in the future even though the utility does not currently have this number of different subscriber classes. The new institutional class was identified as utility subscribers that are engaged in governmental or non-profit activities. Should fewer subscriber classes be

desired, the model operator can set a common tariff to aggregate particular classes into one.

For each subscriber class, there is a table provided for the model operator to define the desired tariff schedule. On the left-hand side of these tariff schedules tables are two columns for user-specified definition of the usage blocks. Up to six different usage blocks are allowed for in the model. By inputting the upper range of the desired block, the model will automatically calculate the starting range of the next block. The highest defined block should be closed off with a large number, such as 999999, to avoid problems in the "if" statements used in the subsequent revenue calculations. If the cell is left blank or text is entered, a logical error will arise in the model. A graph has been provided to show the average subscriber use by various detailed usage increments. This should assist the model operator in identifying groupings of common consumption patterns that would help define the usage blocks for tariff-setting purposes.

Once the desired usage blocks are defined, the model operator can then specify the projected tariffs to meet the desired revenue recovery or policy goals.

2.3 Planning Component

The planning component of the model includes the water demand and water balance worksheets (**WatDem** and **WatBal**) that:

- Project the change or growth in the subscriber base and utility demand;
- Account for water losses in the system to determine supplies needed to meet demands;
- Inventory the quantities of available water supply, compare projected water needs against available supplies, and allow for the rationing of demands (given water shortages) or the allocation of supplies (given water surplus);
- Define the quantity of water use that can actually be met; and
- Define the quantity of water billed.

The planning component provides important data to other portions of the model. The allocation (quantity) of supplies from various sources is used to determine external water and pumping costs. The number of subscribers and water use is then used in revenue and fee calculations.

Water Demand Worksheet

The **WatDem** worksheet provides various tables used in the calculation of the future number of subscribers by type and their level of water demand, use, and quantity of water billed. Summary data is provided at the top of the worksheet along with a series of tables (logical steps) to adjust the forecasts for various

purposes. Importantly, there are also consequent changes in terminology as the tables progress down the worksheet.

A discussion of how residential water demand is calculated and adjusted is provided below; similar concepts also apply to the institutional, commercial, and industrial subscriber classes.

Residential Population

This table uses recent historical estimates of population by residential usage block (number of subscribers by block times persons per subscriber factor) as the most-recent-year-starting basis for the population forecast. The model operator then specifies a projected growth rate (on the global parameter table of the **WatIS** worksheet) for the more aggregated usage blocks associated with the tariff. The formulas in this table distribute this growth rate to the very detailed usage blocks contained herein. The growth rate applied to the historical population yields the projected population (in million persons) for the following year or:

- Projected Population for Usage Block$_n$ in time period $_t$ = (Population for Usage Block$_n$ in Time Period $_{t-1}$ * Percentage Annual Growth Rate for Usage Block$_n$)/1,000,000

Residential Per Capita Daily Water Demand

This table addresses the desired level of per capita water use per day at the service connection of the subscriber. This is specified by the unit demand rates for the more aggregated tariff usage blocks in the global parameter tables on the **WatIS** worksheet. The formulas in this table distribute this growth rate to the very detailed usage blocks contained herein. These per capita factors can be set as policy goals by the government to attain a desired level of per capita water use in the future.

Persons per Subscriber

The data in this table indicate the average number of persons at each subscriber connection by the various detailed usage blocks. This information is used to calculate the number of residential subscribers from the population forecast and can be varied as a planning parameter to simulate changes in population without increases in utility connections. The model operator specifies this factor in the global parameter tables on the **WatIS** worksheet. The formulas in this table distribute the persons per subscriber rate to the very detailed usage blocks contained herein.

Residential Subscribers

The data in this table indicate the number of subscriber connections by detailed usage blocks. This information is used in the calculation of the quarterly meter fee revenue. The number of residential subscribers is calculated by:

- Residential Subscribers = Population/Persons per Subscriber

Residential Water Demand

This table presents the desired level of water use by the various subscriber classes at the service connection of the subscriber. Subscriber demand is driven by the growth rates and unit demand rates in the global parameter tables on the **WatIS** worksheet. These factors can be varied as planning parameters (growth rates) or set as policy goals by the government to attain a desired level of per capita water use in the future. This desired demand may or may not be met by the capability of the water supplies or treatment/delivery system. The demand (in million cubic meters) is calculated by:

- Residential Water Demand = Residential Per Capita Daily Water Use * 365 days/yr. * Population /(1,000,000 * 1,000)

Residential Water Use (after rationing)

The information in this table results from data and decisions made in the **WatBal** worksheet addressing the water balance issues. It is shown on the **WatDem** worksheet as it is the amount of demand actually able to be met, given available water supplies. It reflects either satisfying all demands (given water surplus) or rationing demands (given water shortage).

- Residential Water Use = Residential Water Demand * Residential Rationing Percentage

Residential Water Billed (after rationing)

The information in this table results from data in the Residential Water Use (after rationing) and the Administrative Loss Percentage from the **WatIS** worksheet. It is shown on the **WatDem** worksheet as it is the amount of water actually billed.

- Residential Water Billed = Residential Water Use * (1 - Administrative-Loss-Percentage)

The tables for institutional, commercial, and industrial subscriber classes involve a series of similar calculations, except that their water demand is projected using a historical trend in subscriber growth and a usage rate per subscriber. Water demand for bulk sales and tanker deliveries are projected in a similar manner.

Temporary Working Tables

The tables at the bottom of this worksheet are used as temporary working tables to distribute various information from the more aggregated growth rates to more detailed user blocks. While the current growth structure reflects only a few groupings of usage blocks, the more detailed user blocks on this worksheet will allow the WAJ to monitor a more detailed pattern of water use.

Water Balance Worksheet

Initial Water Balance

The first table on the **WatBal** worksheet addresses an initial water balance calculation of desired water needs versus available supplies.

Supplies Needed to Meet Demands. Because of physical losses in the water system, more water must be supplied than is actually consumed by the subscriber. In the first portion of this table, water demand is adjusted upwards to allow for the anticipated physical losses. Again, desired water demand is obtained from the previous **WatDem** worksheet and the parameters defining the percentages of physical losses are located in the global parameter tables on the **WatIS** worksheet. This physical losses parameter can be varied to reflect improvements in the physical infrastructure.

Detail is shown for various types of water demand: the four customer classes within the retail system, the bulk water demands, and the demand for water from shared resources. Water demand from shared resources was specified separately so that allocation decisions could be made as to how much of these individual resource supplies would be provided to Amman versus other governorates.

Available Water Supplies. This portion of the initial water balance table lists all of the currently available or future supplies and their supply capability, defined as the limiting constraint on supply, whether it is the resource availability or the capacity of various facilities. The model operator may increase the supply capability over time from new projects or project expansions, or alternatively, he can decrease the available supply over time reflecting the depletion of groundwater or other contributing factors.

Initial Water Surplus/Deficit. This is an initial water balance that is simply the difference between supply needed to meet demand and available supplies. It reflects whether there is a surplus or deficit in attempting to meet the desired level of water use. If this balance is negative, then there is a water shortage and water demand must be rationed.

Water Demand Met, Given Supply Conditions

If there is a water shortage from the previous table, water must be rationed. This table allows the model operator to reduce or ration the water demand selectively, by type of user, or uniformly, across all users, until the adjusted water balance at the bottom of table reaches zero. If there is a surplus, the percentage of demand met is 100%. The water demand met resulting from this rationing (or lack thereof) is the total production quantity of the system.

Water Supply Allocation Percentages

This table allows the model operator to control the quantity of supplies from each source in attempting to meet the water demands. One hundred percent of a supply resource can be allocated between Amman and the other governorates, or the total supply provided from a resource may be reduced if there is supply surplus or some other reason to constrain supply such as severe groundwater depletion or some other problem. At the bottom of this table is a final water balance. Under surplus conditions, supplies should be sufficiently constrained at some sources to bring this final water balance to zero in order to avoid supplying more than is demanded.

Water Supplies Used

This table reflects quantity of supply actually used and is calculated by:

- Water Supply Used = Water Supply Source Capacity * Supply Utilization Percentage

When in balance, the “water supplies used” should equal “water demand met adjusted for physical losses.” Each of these quantities represents the total production quantity of the system for that year.

2.4 Revenue Component

The revenue component of the model (**RevSum** worksheet) can be generally separated into tariff revenues and other sources of income. The tariff revenues are based upon detailed information on the number of subscriber accounts, water use by usage blocks, revenue by usage blocks, and adjustments for collections. The other sources of utility income are generally based upon trend information or percentages of other utility measures**.**

Types of Water Revenue and Income

Water Revenue from Retail Subscribers. This revenue is a primary source of income for AGWA. It is collected quarterly through the water bill from all water

subscribers. This revenue is based on applying the water tariff to water consumption. It is forecast according to the following:

- Water Consumption Tariff (adjusted for Customers' & Water Consumption Growth Rates) * Applied Water.

Water Revenue from Bulk Subscribers. This revenue is a primary source of income for AGWA. It is collected by AGWA according to their agreement with the party receiving the water through the water bill, and is based on applying the water tariff on water consumption. It is forecast according to the following:

- Water Consumption Tariff (adjusted for Customers' & Water Consumption Growth Rate) * Applied Water.

Water Revenue from Tankers. This revenue represents the income from sales of drinking water by tankers. This is classified into sales through AGWA tankers and sales through private tankers, which are private, military, and similar institutions' sales. Tanker sales represent a minor source of income when compared to retail and bulk sale. Revenues are forecast according to the following:

- Tankers' Water Consumption (adjusted for Consumption Growth) * Applied Water Tariff.

Water Subscription Fees. This is a subscription fee paid by owners of new connections, calculated according to the new connections for all classes of customers, and based on the applied fees for each class. These fees are forecast according to the following:

- Water Subscription Fees per Applicant (Applied Fees according to Meter Size) * New Connections for all subscriber classes.

Connection Application Fees. This is a connection fee paid by owners of new connections. The fee is calculated according to the new connections for all classes of customers, and is based on a fixed fee for all classes. These fees are forecast according to the following:

- Connection Application Fees per Applicant * New Connection for all subscriber classes.

Re-Connection Fees. This fee represents amounts charged for reconnecting meters previously disconnected by AGWA. It is paid by owners of connections that need to be reconnected. This fee is calculated according to the number of reconnected connections for all classes of customers, and is based on a fixed fee for all classes. These fees are forecast according to the following:

- Re-connection Fees per Applicant * % of Subscribers that re-connect for all subscriber classes.

Complaint Fees. This fee is paid by the subscriber for each complaint submitted and is refunded if the complaint is valid. It is calculated according to invalid complaints submitted by all subscriber classes, and is based on a fixed fee for all classes. These fees are forecast according to the following:

- Complaint Fees per Applicant * % of Subscribers that complain for all subscriber classes.

Leakage Detection Fees. This fee is paid for each request for leakage detection and is paid by the subscriber who submits the request. It is calculated according to requests for leakage detection submitted by all subscriber classes, and is based on a fixed fee for all classes. These fees are forecast according to the following:

- Leakage Detection Fees per Applicant * % of Subscribers who request the leakage detection service.

Counter Fines. This amount represents fines charged for fixing and replacing meters when damaged or when requested by the subscriber to do so. It is calculated according to meters replaced by AGWA, and mainly applies to residential subscribers. These fees are forecast according to the following:

- Counter Fine per Applicant * % of Subscribers with damaged meters.

Other Income. This represents fees from violations of laws and other services. Forecasting of this income will be based on the trends of previous years.

- Current Other Income * Growth Rate.

Water Revenue Worksheet

<u>Residential Water Revenue</u>

This is the actual revenue realized from the sale of water to residential subscribers. The information in this table results from applying the applicable tariff for each block to the data in the table Residential Water Billed (after rationing) from the **WatDem** worksheet. It is shown on the **WatRev** worksheet as it is the amount actually realized.

- Residential Water Revenue = Residential Water Billed * Applied Tariff

The tables for institutional, commercial, and industrial subscriber classes involve similar calculations. Water demand for bulk sales and tanker deliveries are projected in a similar manner.

Water Fee Revenue

This is the actual revenue realized from other fees at AGWA for subscriber classes. The information in this table results from applying the fees (for different activities), the percent of subscribers use of other services, and the number of connections.

Revenue Calculation

The tables at the bottom of this worksheet are used as temporary working tables to distribute various information from the more aggregated tariff user blocks to more detailed user blocks. While the current tariff structure only reflects a few groupings of usage blocks, the more detailed user blocks on this worksheet will allow WAJ to monitor a more detailed pattern of water use. With this information, other possible groupings of usage blocks might be considered for tariff-setting purposes in the future.

2.5 Cost Component

The expenses of AGWA water are split into cost centers, defined in coordination with WAJ to identify the cost of water at the individual major sources, facilities, and transfer points. These centers include sources, pump stations, and networks. The Amman water network, including pumps and boosters, has been considered as one cost center. A separate cost center has been added for the administrative cost of distribution.

Water Cost Centers

The cost centers that are considered in the water model are shown below. Each cost center has a separate sheet in the model. For cost centers that provide water for more than one governorate, the model splits the cost among governorates according to quantity of water delivered.

Water Sources

Deir Alla Tomato
Deir Alla Balqa & Amman
Fuhais
Wala
Khaw
Qatraneh
Swaqa
Qastal
Ain-Ghazal
Nafaq
Madoneh
Qattar
Erenbeh
Musitebeh
Disi

Pump Stations and Network

Pumping Stations & Network Distribution & Customers	Administration

Various water sources for AGWA and cost centers are depicted in Figure 1 along with future sources. The Amman water network and pump stations are considered as one cost center, and its supporting services are split into another cost center to differentiate between the bulk and the retail cost. For shared sources between Governorates, the total costs are recognized in the source cost center, and then allocations are made between Amman and other Governorates according to quantity of water. The Amman share of the cost is added to the total cost of water in AGWA.

Calculating Costs

Total Cost of Producing Water. To calculate the direct cost of producing water, the model will accumulate the following cost centers:

- Total Costs related to sources utilized fully by AGWA;
- AGWA share of the costs of sources shared by different governorates;
- Total Network Costs;
- Total Distribution & Customers Administration; and
- Water Share of General and Administrative Expenses.

Unit Cost For Bulk Sale from WAJ Sources to AGWA. To calculate the cost for bulk sale from WAJ sources to AGWA, the model accumulates the following:

- The cost per m^3 for the source, and
- The cost per m^3 for General and Administrative cost.

Due to the fact that the General and Administrative Expenses information is not available, we have used AGWA General and Administrative Expenses as a basis for calculating unit cost.

Unit Cost For Bulk Sale from AGWA Sources Directly to Other Governorates. To calculate the cost per m^3 for bulk sale from the AGWA sources directly to other Governorates, the model accumulates the following:

- The cost per m^3 for the source, and
- The cost per m^3 of General and Administrative cost related to Water Activities.

Unit Cost For Bulk Sale from AGWA Network to Other Governorates & Institutions. To calculate the cost per m^3 for bulk sale from the AGWA network to other Governorates & Institutions, the model accumulates the following:

- The cost per m^3 for all sources adjusted for the Cost of Bulk Sales from AGWA Sources Directly to Other Governorates;
- The cost per m^3 for Pumping Stations and Network; and
- The cost per m^3 of General and Administrative cost related to Water Activities.

Unit Cost For Retail Sale from AGWA Network to Customers. To calculate the Cost for Retail Sale from AGWA Network to other Governorates & Institutions, the model accumulates the following:

- The cost per m^3 for all sources adjusted for the Cost of Bulk Sales from AGWA Sources Directly to Other Governorates;
- The cost per m^3 for Pumping Stations and Network;
- The cost per m^3 for Distribution & Customers Service; and
- The cost per m^3 of General and Administrative cost related to Water Activities.

A Typical Water Cost Center Sheet

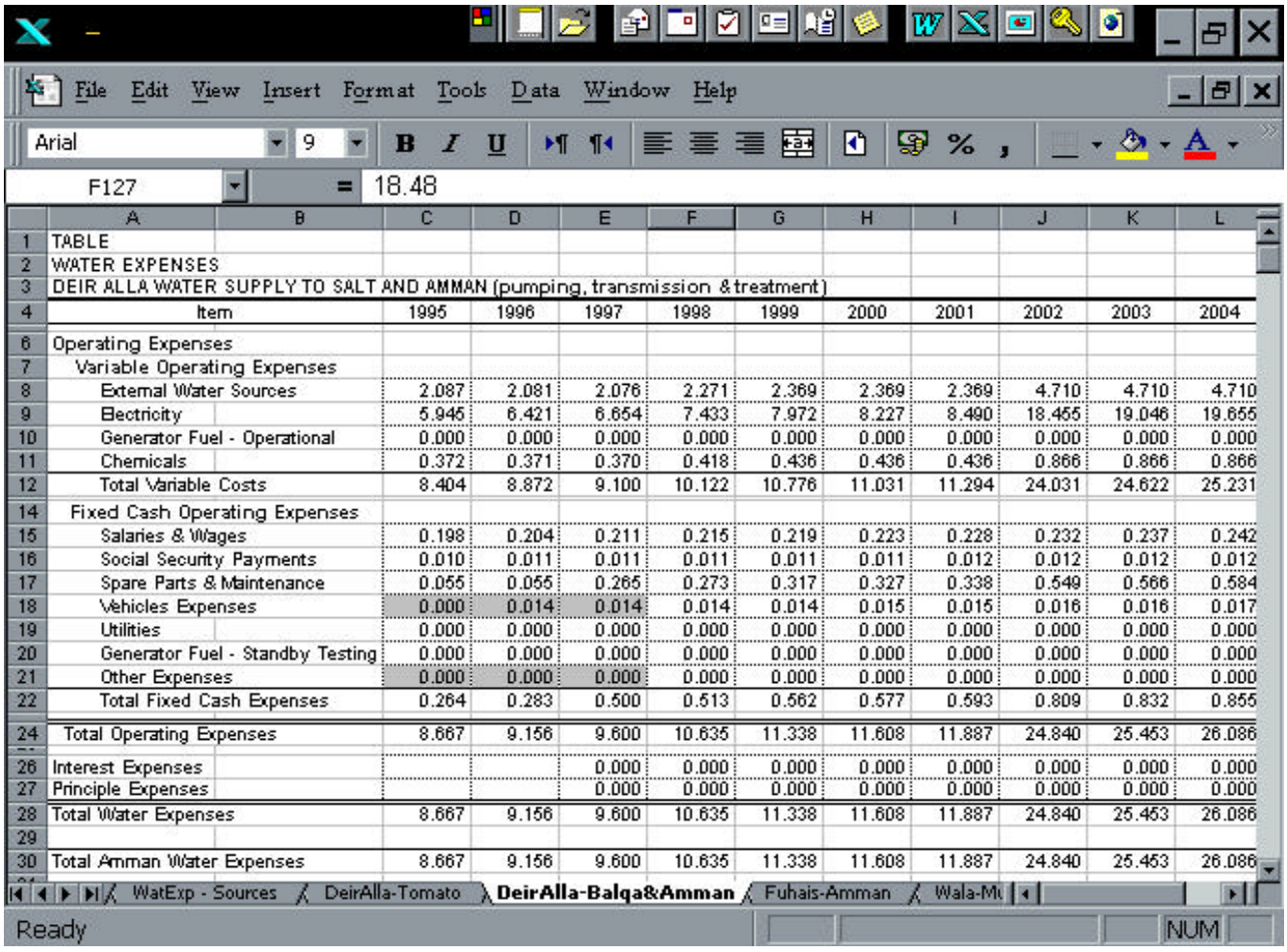
Figure 2 illustrates a typical cost center table. In Row 3, the cost center name is presented. For simplicity, the actual names of the cost centers were used as the names of the sheets in the Excel file. Row 4 presents the years for which the expenses shall be input/forecast. The first column in the table presents all the cost categories as mentioned above. The following paragraphs explain all the cost categories and how are they forecast. The manual also explains the cost centers sheet by sheet.

Water Cost Centers Expenses

Expenses at the cost centers are classified as variable expenses and fixed expenses. Variable expenses include external water, electricity, chemicals, and power generators fuel purchase.They vary proportionally with the quantity of water delivered so that the cost per m^3 is constant. Fixed expenses such as salaries, social security, maintenance, vehicles, and utilities vary, but not in proportion to the quantity of water.

All expenses are expressed in the model as annual expenses. The data on expenses should always be updated. When updating the data, the user should remember that the model is not a cash flow model; the user shall input all expenses even if not paid. The data presented in the model for years 1995 and 1996 are actual data from WAJ records and the OMS Project. Data for year 1997 include actual and forecasted data. Other years throughout the model's period are forecast as described below in the cost categories.

FIGURE 2
EXAMPLE OF A TYPICAL WATER COST CENTER SHEET



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	A	B	C	D	E	F	G	H	I	J	K	L
1	TABLE											
2	WATER EXPENSES											
3	DEIR ALLA WATER SUPPLY TO SALT AND AMMAN (pumping, transmission & treatment)											
4	Item		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
6	Operating Expenses											
7	Variable Operating Expenses											
8	External Water Sources		2.087	2.081	2.076	2.271	2.369	2.369	2.369	4.710	4.710	4.710
9	Electricity		5.945	6.421	6.654	7.433	7.972	8.227	8.490	18.455	19.046	19.655
10	Generator Fuel - Operational		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	Chemicals		0.372	0.371	0.370	0.418	0.436	0.436	0.436	0.866	0.866	0.866
12	Total Variable Costs		8.404	8.872	9.100	10.122	10.776	11.031	11.294	24.031	24.622	25.231
14	Fixed Cash Operating Expenses											
15	Salaries & Wages		0.198	0.204	0.211	0.215	0.219	0.223	0.228	0.232	0.237	0.242
16	Social Security Payments		0.010	0.011	0.011	0.011	0.011	0.011	0.012	0.012	0.012	0.012
17	Spare Parts & Maintenance		0.055	0.055	0.265	0.273	0.317	0.327	0.338	0.549	0.566	0.584
18	Vehicles Expenses		0.000	0.014	0.014	0.014	0.014	0.015	0.015	0.016	0.016	0.017
19	Utilities		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	Generator Fuel - Standby Testing		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	Other Expenses		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	Total Fixed Cash Expenses		0.264	0.283	0.500	0.513	0.562	0.577	0.593	0.809	0.832	0.855
24	Total Operating Expenses		8.667	9.156	9.600	10.635	11.338	11.608	11.887	24.840	25.463	26.086
26	Interest Expenses				0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27	Principle Expenses				0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	Total Water Expenses		8.667	9.156	9.600	10.635	11.338	11.608	11.887	24.840	25.463	26.086
29												
30	Total Amman Water Expenses		8.667	9.156	9.600	10.635	11.338	11.608	11.887	24.840	25.463	26.086

WatExp - Sources | DeirAlla-Tomato | **DeirAlla-Balqa&Amman** | Fuhais-Amman | Wala-Mu

Ready NUM

Variable Expenses

Purchase of Water. This item represents the water transferred from other Governorates, or from Jordan Valley Authority.

- Quantity of Water Transferred * Cost per cubic meter of water.

Electricity. The power required for pumping. Such expenses may be obtained directly from the Electricity Company bill. Electricity consumption and expenses' forecasts are based on previous trends in power consumption kWh/m^3 and cost of Electricity JD/kWh.

- Power consumption per cubic meter of water (kWh/m^3) * Quantity of Water m^3/yr * Cost Per kWh in JD (adjusted for annual Inflation Rate).

Chemicals. The cost of chlorine and other chemicals used for water treatment at the sources and pumping stations. Chlorine is the only chemical used except in the Deir Alla Zai system where water requires full treatment and use of other chemicals. The expenses are estimated based on a chlorine dose rate of 2 mg/liter (2 ton per MCM) and cost of chlorine at JD 425 per ton. Costs of other chemicals used at Zai WTP are added in the same manner. This gives a total cost of chemicals per MCM of water. If the dose rates or the prices of chemicals are different than the assumed ones, then the user should update them. The use of chemicals in the network is forecast as the total quantity used in tons (not per MCM). Chemicals are forecast as follows:

- Cost of Chemicals per million cubic meter of Water (tons) * Water Flow in MCM per year * Inflation Rate.

Generator Fuel. Generator fuel is the expense on fuel used for generating power when there is no permanent electricity supply. This is the case of Madoneh and Qattar. Fuel consumption per cubic meter of water pumped is the basis for estimating expenses.

- Fuel Used in liter per cubic meter of water (liter/m^3)* Cost of Fuel per liter (JD/liter) (adjusted for annual Inflation Rate).

Fixed Expenses

Salaries & Wages. Direct salaries and wages are allocated to each cost center and the rest are accounted for in the General and Administrative Expenses. To assist WAJ in forecasting and adjusting this item we have used number of staff in each cost center, average cost per staff, and inflation rate as a basis for calculation according to the following:

- Average Cost Per Staff (Calculated for each cost center and adjusted for Labor Inflation Rate) * Number of Staff.

Social Security Payments. Calculated as a percentage of Salaries and Wages. This percentage may change over the years since staff on social security are increasing and staff on the retirement plan are decreasing.

- Average percentage of Social Security to Salaries (Calculated for each cost center) * Total Salaries & Wages.

Spare Parts and Maintenance. The expenses of maintaining the cost center facilities. The available records on maintenance expenses for previous years were inaccurate since they do not include cost of labor and spare parts taken from WAJ stores. However, forecasting spare parts and maintenance was based on engineering estimates and trend of previous expenses. Data that are available on existing projects may be used for forecasting expenses on future projects that

are similar in nature. The forecast includes a variable for future change in expenses.

- (Current/estimated Spare Parts & Maintenance including Labor Cost) * Change In Maintenance * Inflation Rate.

Vehicles Expenses. The available records do not provide an accurate break down for the previous years, and Labor Cost is not included. Accordingly, we have allocated vehicles expenses for centers were information is available, and the rest of it is allocated to General and Administrative Expenses. For future years proper allocation should be done to get accurate cost data. The new accounting system implemented in the middle of the year 1997 can be utilized to get the data required for some of the centers inside Amman Service Area. Data that are available on existing projects were used for forecasting expenses on future projects based on the current value of vehicles expenses adjusted for inflation.

- (Current/estimated Vehicles Expenses + Estimated Current Labor) * Inflation Rate.

Utilities. These expenses include central heating fuel, oil and lubricants, water supply, electricity for lighting and services, and telephone. Forecasting is based on previous trends, adjusted for inflation, and according to the cost per staff.

- Cost Per Staff (Based on Current Data for each cost center) * Number of Staff * Inflation Rate.

Generator Fuel – Standby and Testing. The expense of fuel for standby generators in cases of power cutoffs and periodical testing.

- Fuel Used in liters * Cost of Fuel per liter JD/liter (adjusted for Annual Inflation Rate).

Other Expenses. Any other expenses that are not part of the above cost components.

- Current Other Expenses * Inflation Rate.

Debt Service

According to a decision by WAJ, FORWARD has used the debt service method to account for the cost of new projects. This method requires that we account for the interest expenses and principal yearly payments for each project. Both interest and principal will be calculated for governmental loans, local loans, and international loans. Calculation will be made separately for each cost center and will be based on the value of loans, all interest rates applicable, and payments schedule.

- ***Interest.*** This includes interest on amounts borrowed and commitment interest on amounts reserved by lender for the project but not used.

- ***Principal.*** Principal payments include all payments made during the year toward the principal of the loan.

General and Administrative Expenses

G&A expenses are divided into fixed costs and debt service. To calculate the total G&A expenses related to AGWA, we have created two cost centers, one for AGWA G&A and the other for its share of WAJ G&A. We have used staff number of Governorates to allocate the expenses for WAJ G&A. Once the AGWA share of G&A is calculated, the model will allocate the G&A expenses to Water, Tankers, and Wastewater according to their percentage of AGWA total revenue. For both WAJ and AGWA expenses the following procedures have been considered.

Fixed G&A Expenses

Salaries & Wages. For WAJ this includes all salaries and wages related to administrative departments. For AGWA it includes salaries and wages that can not be linked directly to cost centers. To provide accurate allocation of AGWA salaries and wages we have created a separate sheet, **Sal Allocation**. The operator has to feed the details of AGWA administrative salaries and wages (salaries and wages, and number of staff for each department of AGWA), and then the model will allocate salaries using the revenue for each activity as a base for allocation. Number of staff in each cost center, average cost per staff, and inflation rate were used as a basis for calculations to assist WAJ in forecasts and adjustments of this item according to the following:

- Average Cost Per Staff (adjusted for Labor Inflation Rate) * Number of Staff.

Social Security Payments. Calculated as a percentage of salaries and wages. This percentage may change over the years since staff on Social Security are increasing and staff on retirement plans are decreasing.

- Average percentage of Social Security to Salaries * Total Salaries & Wages.

Utilities. Includes fuel for standby generators and central heating, oil and lubricants, water supply, electricity for lighting and services, and telephone. Forecasting expenses on utilities will be based on previous trends adjusted for inflation.

- Cost Per Staff (Based on Current Data for each cost center and adjusted for Annual Inflation Rate) * Number of Staff.

Office Rent. This item represents office rent paid for the use of WAJ and AGWA. The forecasting of this item is based on the current rent expenses adjusted for inflation.

- Current Office Rent * Inflation Rate.

Airspace. Represents amounts paid for airspace for the WAJ telecommunication system. The forecasting of this item is based on the current cost of airspace adjusted for inflation.

- Current cost for Airspace * Inflation Rate.

Stationary & Supplies. Forecasting expenses will be based on previous trends adjusted for inflation.

- Cost Per Staff (adjusted for Inflation Rate) * Number of Staff.

Vehicles Expenses. The available records do not provide accurate break down for the previous years, and labor cost is not included. Accordingly, we have allocated vehicles expenses for centers where information is available, and the rest of it is allocated to General and Administrative Expenses. For future years proper allocation should be made to get accurate cost data. The new accounting system implemented in the middle of the year 1997 can be utilized to get the data required for some of the centers inside the Amman Service Area. Data that are available on existing projects were used for forecasting expenses on future projects that are similar in nature. Forecasting is based on the current value of vehicles expenses adjusted for inflation.

- (Current/estimated Vehicles Expenses + Estimated Current Labor) * Inflation Rate.

***Building Maintenance*.** Represents amounts paid for the maintenance of buildings used in operations. Forecasting is based on the current cost of building maintenance adjusted for inflation.

- Current cost for Building Maintenance * Inflation Rate.

Facilities Maintenance. This item represents amounts paid for the maintenance of facilities used in AGWA and WAJ headquarters. The forecasting of this item is based on the current cost of facilities maintenance adjusted for inflation.

- Current cost of Facilities Maintenance * Inflation Rate.

Cleaning Expenses. This item represents amounts paid for the cleaning contract or materials used. The forecasting of this item is based on the current cost of cleaning expenses adjusted for inflation.

- Current cost for Cleaning Expenses * Inflation Rate.

Laboratory Testing. This expense is related to water quality tests performed by WAJ Central Labs for AGWA on sources of water. Expenses on laboratory tests were available for the whole AGWA but not per cost center. Forecasting expenses on laboratory tests is based on current expenses, increase in water supplies, percentage of number of samples tested compared to WHO Guidelines, and inflation in the cost of testing.

- Current Expenses (JD) * Percentage of Growth Rate in Water System Supplies (%) * Percentage of WHO Guidelines * Inflation Rate.

Other Expenses. This includes any other expenses that are not part of the above cost components.

- Current Other Expenses * Inflation Rate.

Debt Service G&A Expenses

According to a decision by WAJ, FORWARD has used the debt service method to account for the cost of new projects. This method requires that we account for the interest expenses and principal yearly payments for each project. Both interest and principal will be calculated for governmental loans, local loans, and international loans. Calculation will be made separately for each cost center and will be based on the value of loans, all interest rates applicable, and payments schedule.

- ***Interest.*** This includes interest on amounts borrowed and commitment interest on amounts reserved by lender for the project but not used.

- ***Principal.*** Principal Payments include all payments made during the year toward the principal of the loan.

Water Cost Center Worksheets

Below are the details of additional expenses for particular cost centers.

Deir Alla Tomato. The water treatment plant at the tomato factory at Ardah.

- External Water. Raw water is transferred and purchased from JVA at the King Abdullah Canal (Deir Alla) diversion to Amman.

Deir Alla Balqa & Amman. The Deir Alla/Zai system from the intake facilities to Dabuq Reservoir.

- External Water. Raw water is transferred from JVA at King Abdullah Canal.

- Chemicals. The cost of chemicals is higher here than at other cost centers because of the use of aluminum sulfate, polymer, activated carbon and potassium permanganate in addition to chlorine.

Fuhais. Receives water from two sources with different costs: from a local spring and through a turnout from Deir Alla. The amount of water supplied to Amman from Fuhais is the total amount from Deir Alla to Fuhais, which has a higher cost, plus part of the local spring water.

Wala. A cost center outside Amman that delivers water to Muntazah pump station. All of the facilities of this system from the wellfield at Hedan up to Muntazah are considered part of the cost center. Muntazah pump station is part of the Network cost center.

Khaw. An external cost center outside Amman which includes all the facilities that supply water to Khaw: Azraq, Khaldia, Halbat, and others.

Qatraneh. No chemicals are used at Qatraneh because the water is chlorinated at Swaqa, the next pump station.

- Chemicals. Zero

Swaqa. The quantity of water should be the amounts delivered from Qatraneh and produced in Swaqa.

- Electricity

Ain-Ghazal. Includes the Ain Ghazal group of wells: Ruseifeh, Tadj and Yajouz. Ain Ghazal and Yajouz pump stations are part of the Network cost center.

Nafaq. Includes the Nafaq group of wells and springs: Muhajereen, Ras Al Ain, Wadi Saqra, Wadi Esseir and Muwaqar. It does not include Nafaq pump station which is part of the Network cost center.

Madoneh. No permanent electricity supply from the Electricity Company. Generators are used for permanent power supply.

- Electricity. Not applicable.

- Generator Fuel

Qattar. No permanent electricity supply from the Electricity Company. Generators are used for permanent power supply.

- Electricity. Not applicable.

- Generator Fuel

Disi. Considered an external cost center that supplies Amman with bulk water (BOT Project). Only external water expenses apply. The cost of water includes all expenses.

Pumping Stations & Network. This cost center includes all the pump stations, boosters, reservoirs and networks including Muntazah pump station, Ain Ghazal pump station and Nafaq pump station. The forecast is based on the total electricity consumption kWh and not per cubic meter, and the total quantity of chlorine used in ton and not cost per MCM.

- Electricity
- Chemicals

CHAPTER THREE
AGWA WASTEWATER MODEL

3.1 Overview

At its simplest level, the AGWA-WW model contains four major analytical components or processes that represent either a single worksheet or groups of worksheets:

- **Financial/Model Parameters Component**

  Contains the model's summary financial information in tabular and graphical form as well as global model parameters that, when changed, can have widespread effects upon the model's calculations and results.

- **Planning Component**

  Contains the various underlying factors and calculations affecting system growth and wastewater use.

- **Revenue Component**

  Contains the calculations that generate system subscriber revenue and fees as well as adjustments to revenue.

- **Cost Component**

  Contains the various cost centers of the utility, the local parameters that uniquely affect their expenses, the calculation of costs, and various aggregations of cost centers used for tariff considerations.

The underlying details of the AGWA-WW model are somewhat more complicated with a larger number of sub-components addressing various planning, engineering or financial issues and data flowing from one portion of the model to another.

While input parameters affecting the calculations are present at various steps throughout, the model essentially begins with demographic/economic growth and customer issues giving rise to projected wastewater flows and customer use. The quantity of wastewater released to the system is then used with other data to determine the expenses of various cost centers. The cost data is then aggregated in a certain manner for financial analyses.

Expected system income is generated from customer counts and usage data multiplied by the applicable tariffs and fee schedules and then adjusted for billing

collections. This expected income is then compared with expenses, resulting in the net income of the system. Management decisions can change variables underlying utility income or expenses to see the affect on desired performance goals.

Wastewater Model Components and Worksheets

Financial/Model Parameters Component	
WW IS	Wastewater Utility Balance Sheet and Global Parameters
Planning Component	
WWUse	Total Subscribers, Billed and Used by Customer Class
WWFlow	Wastewater Flows to Wastewater Treatment Plants (WWTPs)
Revenue Component	
WWRev	Wastewater Income
Cost Component	
Perf. Ind	Wastewater Expenses – Performance Indicators
Cost Summary	Wastewater Expenses
WWatExp	Wastewater Expenses
Assamra WSP	Wastewater Expenses – Assamra
Abu Nusair WWTP	Wastewater Expenses – Abu Nusair
Baqa'a WWTP	Wastewater Expenses – Baqa'a
Wadi Esseir WWTP	Wastewater Expenses – Wdai Esseir
Fuhais WWTP	Wastewater Expenses – Fuhais
Naur WWTP	Wastewater Expenses – Naur
S. Amman (East) WWTP	Wastewater Expenses – S. Amman – East
S. Amman (West) WWTP	Wastewater Expenses – S. Amman – West
S. Amman-Lan App	Wastewater Expenses – S. Amman – Land Application
Zarqa WWTP	Wastewater Expenses – Zarqa
Ain Ghazal Headworks	Wastewater Expenses – Ain Ghazal Headworks
W. Zarqa PS	Wastewater Expenses – West Zarqa Pumping Station
Fuhais PS 1&2	Wastewater Expenses – Fuhais Pumping Stations 1 and 2
Existing Siphon	Wastewater Expenses – Existing Siphon
New Siphon	Wastewater Expenses – New Siphon
Amman Network	Wastewater Expenses – Amman Network
Balqa-Baqa'a Network	Wastewater Expenses – Balqa to Baqa'a
Balqa-Fuhais Network	Wastewater Expenses – Balqa to Fuhais Network
West Zarqa Network	Wastewater Expenses – West Zarqa Network
G&A	General and Administrative Expenses – Waste Water
Others	
TP WW	Summary of Salaries and Social Security for WWTPs and Headworks
Schematic	Amman Wastewater System – Schematic Diagram
Data1	Wastewater Expenses – 1993 Data
Data2 (2)	Miscellaneous Wastewater Data
Flow	Wastewater Flows

3.2 Financial Summary and Global Model Parameter Component

This component of the model, being summary and/or input data in nature, resides on a single sheet, **WW IS**. It contains the summary financial performance of the utility (income statements), various performance measures, and global parameters that affect large portions of the model when changed by the user. For the most part, this component contains the main drivers of the model (global parameters) as well as the results (income statement and performance measures). The beginning and ending pieces are packaged together to allow the model operator to perform what-if scenarios on the parameters and quickly see the overall results of the changes.

Income Statements Worksheet

Net Income

The first table, relating the net income of the utility, represents the highest level of information in the model. Any significant change to the model's parameters alters the financial data in this table. Much of the data for this table are obtained from worksheets in other components that summarize the revenue and costs of the water utility. The data are simply passed to the net income table for presentation and subsequent calculation of the utility's net income.

The model calculates three different levels of net income:

- net income after operating expenses;
- net income after operating and interest expenses; and
- net income after operating, interest, and principle expenses (full cost recovery).

These three performance levels are also provided as percentage terms. This last item (percent of revenue recovery goals) is most useful in specifying alternative tariff schedules and ascertaining the change in revenue's impact on the targeted revenue recovery goal.

Graphs

Below the net income table are various informative graphs on the utility's performance that will assist the model operator and decision-makers in interpreting the model's results.

Global Model Parameters

Below these graphs are various tables identifying the model's global parameters. They include tables for various user-specified data on common costs such as electricity and fuel, inflation rates, efficiency rates, and tariff levels. Changes in this variable will likely affect multiple underlying worksheets and have a more noticeable effect upon the utility's financial performance.

The historical data for these parameters, shown for the first few years, can be used as an initial starting basis for the user-specified projected values of these parameters. Projected changes from this historical value or trend for future years can then be made based upon known effects of planned projects, new negotiated prices, information received from other ministries or agencies, desired policy targets, or best professional guesses of staff.

The model has been structured to allow for separate residential, institutional, commercial, and industrial tariffs schedules although the utility does not currently have this number of different subscriber classes in their adopted tariff schedules. The new institutional class is utility subscribers engaged in governmental or non-profit activities. Should less than four subscriber classes be desired, the model operator can set a common tariff to aggregate a grouping of subscriber classes into one class.

For each subscriber class, there is a table provided in the model for the operator to define the desired tariff schedule for that class. On the left-hand side of these tariff schedules tables are two columns for the user-specified definition of the usage blocks. Up to six different usage blocks are allowed in the model. By inputting the upper range of the desired block, the model will automatically calculate the starting range of the next block. In the highest defined block, this usage block should be closed off with a large number, such as 999999, to avoid problems in the if statements used in the subsequent revenue calculations. If the cell is left blank or text is entered, a logical error will arise in the model. A graph has been provided in the model to show the average subscriber use by various detailed usage increments. This should assist the model operator in identifying groupings of common consumption patterns that would help define the usage blocks for tariff-setting purposes.

Once the desired usage blocks are defined, the model operator can specify the projected tariffs to meet the desired revenue recovery or policy goals.

3.3 Planning Components

The planning component of the model includes the wastewater use and wastewater flow worksheets (**WWUse** and **WWFlow**) that:

- Project the change or growth in the subscriber base and utility use;

- Project the change in the flow of wastewater from Amman to wastewater facilities; and
- Define the quantity of wastewater billed.

The planning component provides important data to other portions of the model. The allocation (quantity) to various facilities is later used to determine transport, disposal, and treatment costs. The number of subscribers and wastewater use is then used in revenue and fee calculations.

Wastewater Use Worksheet

The **WWUse** worksheet provides various tables used in the calculation of the future number of subscribers connected to wastewater by type, their level of water use, and quantity billed. Summary data and a series of tables (logical steps) to adjust the forecasts for various purposes are provided at the top of the worksheet. Importantly, there are also consequent changes in terminology as the tables progress down the worksheet.

A discussion of how residential wastewater use is calculated and adjusted is provided below; similar concepts apply to the other three defined subscriber classes: institutional, commercial, and industrial.

Residential Wastewater Subscribers

The data in this table indicate the number of subscribers with wastewater connections by detailed usage blocks. The number of residential wastewater subscribers is calculated by:

- Residential Wastewater Subscribers = Last Year Number of Subscribers + (Number of New WW Subscribers * % of Residential New Subscribers to Total New WW Subscribers)

Residential Water Use (with wastewater connections)

The information in this table results from historical data adjusted for the expected growth in water.

- Residential Water Use (with wastewater connections) = Last Year Use * (1+% of Growth in Water Received from Amman)

Residential Water Billed (with wastewater connections)

The information in this table results from data in the Residential Water Use (with wastewater connections) and the Administrative Loss Percentage from the

WW IS worksheet. It is shown on the WWUse worksheet as it is the amount of water actually billed.

- Residential Water Billed (with wastewater connections) = Residential Water Use (with wastewater connections) * (1 – Administrative Loss Percentage)

For institutional, commercial, and industrial subscriber classes a series of similar calculations are used.

The following table provides information on the allocation of new wastewater connections to different subscriber classes.

Wastewater Flow Worksheet

Wastewater Flow to Each Facility

These tables provide the model with the change in the wastewater flow to each facility. It is based on historical flow adjusted for growth of water use and new wastewater connections.

- Wastewater Flow to each facility = (Last Year Flow * Growth in Water Use) + (Average Water Use by Each Subscriber * Number of New Subscribers * Return Flow % * Change in Infiltration)

3.4 Revenue Component

The revenue components of the model (**WWRev** worksheet) can be separated into tariff revenues and other sources of income. The tariff revenues are based upon detailed information on number of subscribers with wastewater accounts, water use by usage blocks, revenues by usage blocks, and adjustments for collections. The other sources of utility income are generally based upon trend information or percentages of other utility measures.

Types of Wastewater Revenue and Income

Fees on Sewage Collection and Treatment Service. These fees are considered the primary income for AGWA, collected quarterly by AGWA through the water bill, and are based on applying the tariff for wastewater on the water consumption. They are collected from subscribers living in sewered areas whether their houses are connected to the sewer network or not. The sewage collection fee is charged according to the amount of water consumed. Revenues from these fees will be forecast for the whole AGWA area despite various catchment areas. These fees are forecast according to the following:

- Water Consumption Tariff (adjusted for Growth Rate for Customers & Water Consumption) * percentage of Sewered Areas in Amman * Applied Wastewater Tariff.

New Connection Fee of 25% of Annual Rental Value. This is a connection fee paid by owners of new connections at 25% of annual rental value. For empty houses (not rented) and for new houses, the annual rental value is estimated. Owners usually claim that the fee is overestimated. Refunds are paid on overestimation. Revenues out of this fee have a natural annual growth in addition to revenues resulting from new projects.

- Current New Connection Fee of 25 % of Annual Rental Value * Inflation Rate * Growth Rate for New Connections (General Growth & New Projects Growth).

New Connection (Sewerage Connection) Fee. This is a subscription fee paid by owners of new connections. The fee varies with the classification of the housing area (A, B, C, D, and E). These classes of houses are part of the building planning regulations. Revenues out of this fee should have growth rates similar to the growth in the 25% fee.

- Current New Connection (Sewerage Connection) Fee * Inflation Rate * Growth Rate for New Connections (General Growth & New Projects Growth).

Sewerage Tax of 3%. This fee represents people's participation in construction of sewerage facilities. The fee is collected by the Ministry of Finance and is paid annually at 3% of annual rental value. Every house owner pays it whether located in a sewered area or not. Forecasting this fee will be based on previous trends representing its growth. It is not accounted for in the model.

- Current Sewerage Tax of 3% of Annual Rental Value* Inflation Rate * Growth Rate.

Fees on Septage Disposal by Tankers (Sewage Tanker Income). Private tankers for septage disposal pay a monthly fee of 20 JD. This fee has a natural growth rate because of new houses in non-sewered areas and increases in water consumption. New projects (the extension of existing networks and new service areas) will decrease this income.

- Current Fees on Septage Disposal by Tankers (Sewage Tankers Income) * Inflation Rate * Growth Rate (General Growth netted against New Projects' effects).

Sewer Cleaning and Flushing Income. Private sector and other governmental bodies pay fees on cleaning and flushing of their sewers by AGWA staff. Forecasting of this income will be based on trends from previous years.

- Current Sewers Cleaning and Flushing Income * Inflation Rate.

Other Sewerage Income. Represents fees from violations of laws and other services. Forecasting of this income will be based on trends from previous years.

- Current Other Sewerage Income * Inflation Rate.

Wastewater Revenue Worksheet

Residential Wastewater Revenue

The information in this table results from applying the wastewater tariff applicable for each block to the data in the Residential Water Billed (for subscribers with wastewater connection) from the **WWUse** worksheet. It is shown on the **WWRev** worksheet as it is the amount actually realized.

- Residential Wastewater Revenue = Residential Water Billed (with wastewater connections) * Applied Tariff

The tables for institutional, commercial, and industrial subscriber classes involve similar calculations.

Wastewater Fee Revenue

This table presents the actual revenues realized from other fees at AGWA for subscriber classes. The information in this table results from applying the fees for different activities, percentage of subscribers use of other services, and number of connections.

Wastewater Revenue Calculation Tables

The tables at the bottom of the worksheet are used as temporary working tables to distribute information from the more aggregated tariff user blocks to more detailed user blocks. While the current tariff structure only reflects a few groupings of usage blocks, the more detailed user blocks will allow WAJ to monitor a more detailed pattern of water use. With this information, other possible groupings of usage blocks may be considered for tariff-setting purposes in the future.

3.5 Cost Component

The expenses of AGWA wastewater are split into cost centers, defined in coordination with WAJ in order to identify wastewater treatment costs at major individual facilities. These centers include wastewater treatment plants, pump stations, and networks. Despite the fact that the sewage in Amman flows to

more than one wastewater treatment plant, the Amman sewer networks have been considered as one cost center.

Wastewater Cost Centers

The cost centers that are considered in the wastewater model are listed below. Expenses of cost centers that provide service for more than one Governorate are split among the participants of the service. Splits in expenses is usually based on relative wastewater flows form the participants. Blank sheets have been included for future projects.

Wastewater Treatment Plants

Assamra WSP
Abu Nusair WWTP
Baqa'a WWTP
Wadi Esseir WWTP
Fuhais WWTP
Na'ur WWTP
South Amman (East) WWTP
South Amman (West) WWTP
South Amman Land Application Plants
Zarqa WWTP

Pump Stations, Headworks, and Major Pipelines

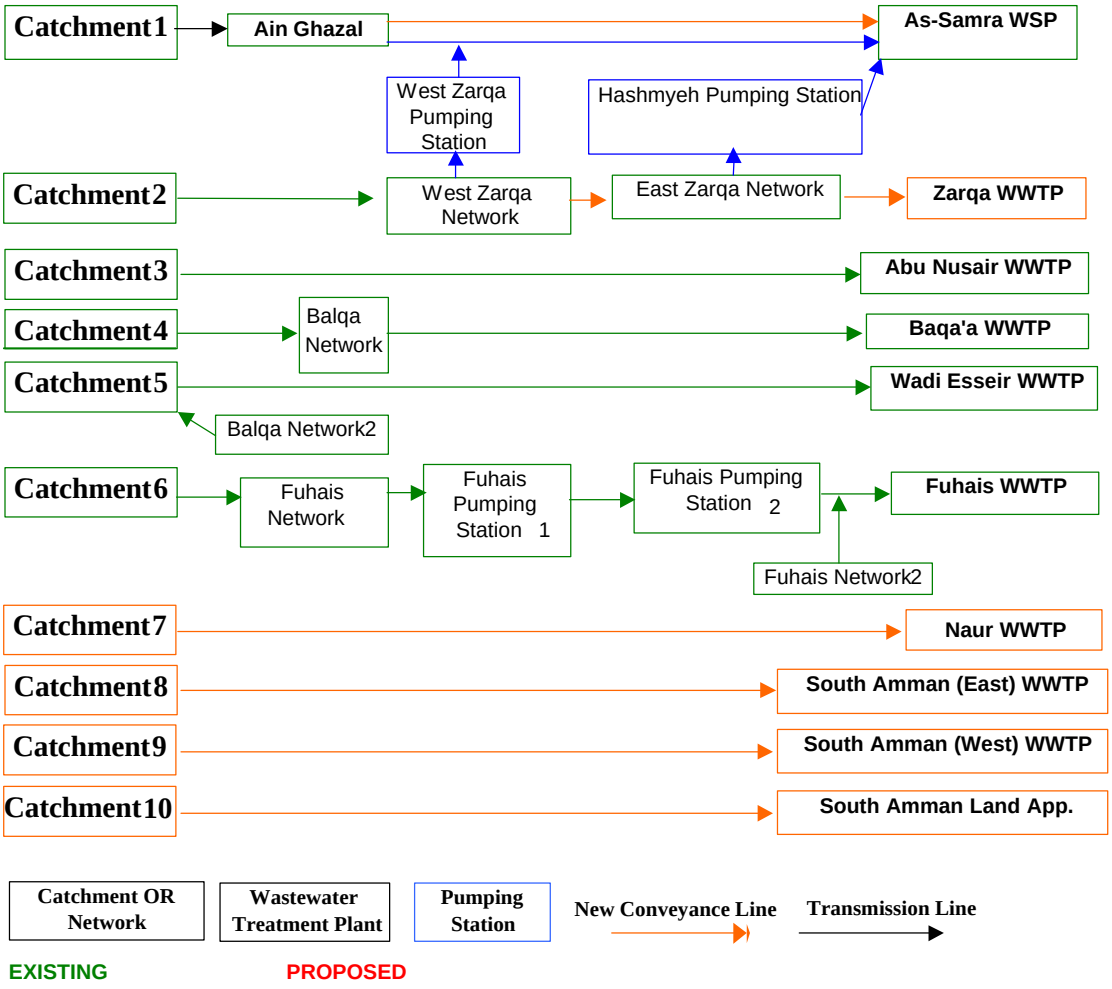
Ain Ghazal Headworks
West Zarqa Pump Station
Fuhais Pump Stations (1&2)
Transmission Pipelines
Existing Siphon
New Siphon

Networks

Amman Network
Network of Balqa to Baqa'a
Network of Balqa to Fuhais
West Zarqa Network

Figure 3 shows the various catchment areas of AGWA, existing cost centers, and future wastewater treatment facilities. The Amman sewer networks, consisting of a number of catchment areas, are considered as one cost center except in cases where Amman wastewater flows to facilities in surrounding Governorates. Then these facilities are included as separate cost centers in order to split the costs between the other Governorates and AGWA. However, cost of use of other governorates' networks is considered as financial compensation between governorates in the model. This approach was coordinated with WAJ Staff because actual spliting of shared networks' expenses can not be based on wastewater flows or length of shared networks.

FIGURE 3
AMMAN WASTEWATER SYSTEM SCHEMATIC DIAGRAM

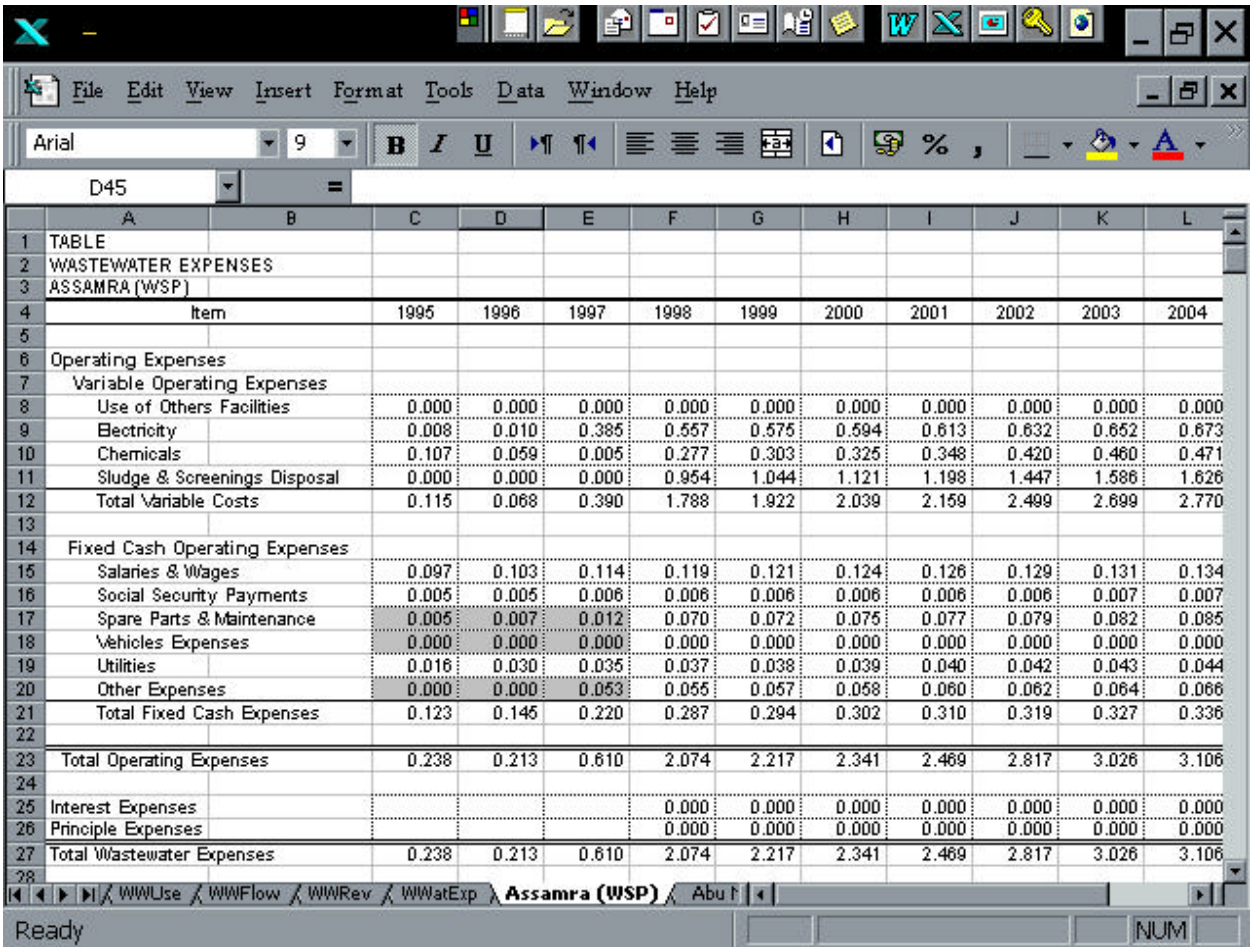


The schematic diagram shows the existing facilities and planned projects.

A Typical Wastewater Cost Center Sheet

Figure 4 shows a typical cost center sheet. In Row 3, the cost center name is presented. For simplicity, the actual names of the cost centers were used as the names of the sheets in the Excel file. Row 4 presents the years for which the expenses shall be input/forecast. The first column in the table presents all the cost categories as mentioned above.

FIGURE 4
EXAMPL OF A TYPICAL WASTEWATER COST CENTER SHEET



	A	B	C	D	E	F	G	H	I	J	K	L
1	TABLE											
2	WASTEWATER EXPENSES											
3	ASSAMRA (WSP)											
4	Item		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
5												
6	Operating Expenses											
7	Variable Operating Expenses											
8	Use of Others Facilities		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	Electricity		0.008	0.010	0.385	0.557	0.575	0.594	0.613	0.632	0.652	0.673
10	Chemicals		0.107	0.059	0.005	0.277	0.303	0.325	0.348	0.420	0.460	0.471
11	Sludge & Screenings Disposal		0.000	0.000	0.000	0.954	1.044	1.121	1.198	1.447	1.586	1.626
12	Total Variable Costs		0.115	0.068	0.390	1.788	1.922	2.039	2.159	2.499	2.699	2.770
13												
14	Fixed Cash Operating Expenses											
15	Salaries & Wages		0.097	0.103	0.114	0.119	0.121	0.124	0.126	0.129	0.131	0.134
16	Social Security Payments		0.005	0.005	0.006	0.006	0.006	0.006	0.006	0.006	0.007	0.007
17	Spare Parts & Maintenance		0.005	0.007	0.012	0.070	0.072	0.075	0.077	0.079	0.082	0.085
18	Vehicles Expenses		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	Utilities		0.016	0.030	0.035	0.037	0.038	0.039	0.040	0.042	0.043	0.044
20	Other Expenses		0.000	0.000	0.053	0.055	0.057	0.058	0.060	0.062	0.064	0.066
21	Total Fixed Cash Expenses		0.123	0.145	0.220	0.287	0.294	0.302	0.310	0.319	0.327	0.336
22												
23	Total Operating Expenses		0.238	0.213	0.610	2.074	2.217	2.341	2.469	2.817	3.026	3.106
24												
25	Interest Expenses					0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	Principle Expenses					0.000	0.000	0.000	0.000	0.000	0.000	0.000
27	Total Wastewater Expenses		0.238	0.213	0.610	2.074	2.217	2.341	2.469	2.817	3.026	3.106
28												

The expenses at the cost centers are classified as variable expenses and fixed expenses. Variable expenses vary proportionally with wastewater flows (i.e. cost per m^3 is constant). Fixed expenses vary, however, not proportionally with flows such as salaries. Fixed expenses are almost fixed for different flows.

Wastewater Cost Center Expenses

In order to determine variable costs, it is necessary to identify the wastewater flows throughout the model's period of 1995 to 2007 at the transfer points and cost centers. The wastewater flows will be used in forecasting the expenses that are variable with the flow, such as electricity, chemicals use, and sludge disposal. Wastewater flows are also necessary for splitting of costs at the shared cost centers:

- From Amman to Ain Ghazal
- From Amman to Zarqa West
- From Zarqa West Pump Station to Siphon

- At Assamra WSP
- At Abu Nusair WWTP
- From Amman (Sweileh) to Baqa'a
- At Baqa'a WWTP
- From Balqa to Wadi Esseir Network
- At Wadi Esseir WWTP
- From Amman (Princess Haya Suburb) to Fuhais
- From Fuhais Pump Station 2 to Fuhais WWTP
- Fuhais WWTP
- From Amman to Na'ur
- From Amman to South Amman (East) WWTP
- From Amman to South Amman (West) WWTP
- At Zarqa WWTP

Variable expenses in the wastewater cost centers are electricity, chemicals use and sludge disposal. Fixed expenses are expenses on salaries, social security, maintenance, vehicles, utilities and other. All expenses are expressed in the model as annual expenses. The data on expenses should always be updated. When updating the data the user should remember that the model is not a cash flow model. The user shall input all expenses even if not paid. The data presented in the model for years 1995 and 1996 are actual data from WAJ records. Data for year 1997 include actual and forecast data. Other years throughout the model's period are forecast as described below in the cost categories.

The following paragraphs explain all the cost categories and how they are forecast. The manual also explains the cost centers sheet by sheet.

Variable Expenses

Use of Others Facilities.

- Flow of Wastewater in the Facility - Amman Share * Cost per cubic meter of wastewater.

Electricity. Electricity is the expense on power by the wastewater facilities (i.e. pumps, aerators, etc.). Such expenses may be obtained from the electricity company bill. Forecasting electricity consumption and expenses are based on previous trends of power consumption kWh/m^3 and cost of Electricity JD/kWh.

- Power consumption per cubic meter of wastewater (kWh/m^3) * Wastewater flow in m^3/yr * Cost per kWh in JD * JD (adjusted for Annual Inflation Rate).

Chemicals. Costs associated with disinfecting wastewater, such as chlorine, and chemicals used for odor removal, such as sodium hydroxide. Chemicals are usually used in the wastewater treatment works but not pump stations and

networks. The expenses are estimated based on a chlorine dose rate of 10 mg/liter (10 tons per MCM) and cost of chlorine at JD 425 per ton. Costs of other chemicals are added in the same manner. This gives a total cost of chemicals per MCM of wastewater. If the dose rates or the prices of chemicals are different from those assumed, the user should update the data. Chemicals' expenses are forecast as follows:

- Cost of Chemicals per MCM of wastewater (Ton) * Wastewater flow in MCM per year * Inflation Rate.

Sludge and Screening Disposal. Cost of sludge disposal per cubic meter of wastewater flow or JD/MCM is determined based on previous trends. Facilities that have no record are based on other existing facilities that have the same treatment method, concentration of suspended solids and distances from disposal site.

- Sludge Disposal JD/MCM * Wastewater flow in MCM/year * Inflation Rate.

Fixed Expenses

Salaries & Wages. Direct salaries and wages were allocated to each cost center, and the rest were accounted for in the General and Administrative Expenses. To assist WAJ in forecasting and adjusting this item we have used number of staff in each cost center, average cost per staff, and inflation rate as a basis for calculation according to the following:

- Average Cost Per Staff (Calculated for each cost center and adjusted for Labor Inflation Rate) * Number of Staff.

***Social Security Payments*.** Calculated as a percentage of Salaries & Wages. This percentage may change over years since staff on Social Security are increasing and staff on retirement plans are decreasing.

- Average percentage of Social Security to Salaries (Calculated for each cost center) * Total Salaries & Wages.

Spare Parts and Maintenance. The available records on maintenance expenses for previous years are inaccurate. The records do not include cost of labor and spare parts taken from WAJ stores. However, forecasting spare parts and maintenance was based on the trends for previous years. The cost of labor and spare parts were estimated and also considered. Data that are available on existing projects may be used for forecasting expenses on future projects that are similar in nature. The forecast, which is based on previous trends, includes a variable for change in expenses.

- (Current/estimated Spare Parts & Maintenance including Labor Cost) * Change in Maintenance * Inflation Rate.

Vehicles Expenses. The available records do not provide accurate break down for the previous years, and labor cost is not included. Accordingly, we have allocated vehicles expenses for centers where information is available, and the rest of it was allocated to General and Administrative Expenses. For future years proper allocation should be performed to obtain accurate cost data. The new accounting system implemented in AGWA in the middle of 1997 can be utilized to get the data required for some of the centers inside the Amman service area. Data available on existing projects were used for forecasting expenses on future projects that are similar in nature. The forecasting of this item is based on the current value adjusted for inflation.

- (Current/estimated Vehicles Expenses + Estimated Current Labor) * Inflation Rate.

Utilities. Includes fuel for stand by generators and central heating, oil and lubricants, water supply, electricity for lighting and services, telephone, and pesticides. Forecasting expenses on utilities will be based on previous trends adjusted for inflation and according to cost per staff.

- Cost Per Staff (based on current data for each cost center) * Number of Staff * Inflation Rate.

Other Expenses. Includes materials for laboratories, wastewater quality tests carried by the Royal Scientific Society (RSS), and any other expenses that are not part of the above cost components. It should be noted that the cost of laboratory tests carried out by WAJ Central Labs are part of general expenses because these expenses are not split per cost center.

- Current Other Expenses * Inflation Rate.

Debt Service

According to WAJ decision, the debt service method has been used to account for the cost of new projects. This method requires that the interest expenses and principal yearly payments for each project are accounted for. Both interest and principal will be calculated for government loans, local loans, and international loans. Calculation will be done for each cost center separately and will be based on the value of loans, all interest rates applicable, and payments schedule.

- **Interest.** Includes Interest on amounts borrowed, and commitment interest on amount reserved by lender for the project but not used.

- **Principal.** Principal payments include all payments made during the year toward the principal of the loan.

General and Administrative Expenses

The cost sheet for the details of General and Administrative Expenses is available in the water model, and then it is allocated between water and wastewater. General and Administrative Expenses are divided into fixed costs and debt service. To calculate the total General and Administrative Expenses related to AGWA, we have created two cost centers, one for AGWA General and Administrative Expenses and the other center for AGWA share from WAJ General and Administrative Expenses. For WAJ General and Administrative Expenses, the number of staff for each Governorate has been used to allocate expenses. Once the AGWA share of General and Administrative Expenses is calculated, the model will allocate the General and Administrative Expenses to Water, Tankers, and Wastewater according to their revenue percentage of the total revenue of AGWA. For both WAJ and AGWA expenses the following procedures have been considered.

Fixed G&A Expenses

Salaries & Wages. For WAJ this includes all salaries and wages related to administrative departments, and for AGWA it includes salaries and wages that can not be linked to cost centers directly. To provide accurate allocation of AGWA salaries and wages a separate sheet, **Sal Allocation,** has been created. In this sheet the operator has to feed the details of AGWA administrative salaries and wages (salaries and wages, and number of staff for each AGWA department), and then the model will allocate salaries using the revenue for each activity as a base for allocation. To assist WAJ in forecasting and adjusting this item we have used number of staff in each cost center, average cost per staff, and inflation rate as a basis for calculation according to the following:

- Average Cost Per Staff (adjusted for Labor Inflation Rate) * Number of Staff.

Social Security Payments. Calculated as a percentage of Salaries & Wages. This percentage may change over years since staff on Social Security are increasing and staff on retirement plan are decreasing.

- Average percentage of Social Security to Salaries * Total Salaries & Wages.

Utilities. Includes fuel for standby generators and central heating, oil and lubricants, water supply, electricity for lighting and services, and telephone. Forecasting expenses on utilities will be based on previous trends adjusted for inflation.

- Cost Per Staff (based on current data for each cost center and adjusted for Annual Inflation Rate) * Number of Staff.

Office Rent. Represents office rent paid by WAJ and AGWA. The forecasting of this item is based on the current rent expenses adjusted for inflation.

- *Current Office Rent * Inflation Rate.*

Airspace. Represents amounts paid for airspace for the use of WAJ telecommunication system. The forecasting of this item is based on the current cost of airspace adjusted for inflation.

- Current cost for Airspace * Inflation Rate.

Stationary & Supplies. Forecasting expenses will be based on previous trends adjusted for inflation.

- Cost Per Staff (adjusted for Inflation Rate) * Number of Staff.

Vehicles Expenses. The available records do not provide accurate break down for the previous years, and labor cost is not included. Accordingly, we have allocated vehicles expenses for centers where information is available, and the rest of it was allocated to General and Administrative Expenses. For future years proper allocation should be performed to obtain accurate cost data. The new accounting system implemented in AGWA in the middle of 1997 can be utilized to get the data required for some of the centers inside the Amman service area. Data available on existing projects were used for forecasting expenses on future projects that are similar in nature. The forecasting of this item is based on the current value adjusted for inflation.

- (Current/estimated Vehicles Expenses + Estimated Current Labor) * Inflation Rate.

Building Maintenance. Represents amounts paid for the maintenance of buildings used in operations. The forecasting of this item is based on the current cost adjusted for inflation.

- Current cost of Building Maintenance * Inflation Rate.

Facilities Maintenance. Represents amounts paid for the maintenance of facilities used in AGWA and WAJ headquarters. The forecasting of this item is based on the current cost adjusted for inflation.

- Current cost of Facilities Maintenance * Inflation Rate.

Cleaning Expenses. Represents amounts paid for cleaning contracts or materials. The forecasting of this item is based on the current cost adjusted for inflation.

- Current cost of Cleaning Expenses * Inflation Rate.

Laboratory Testing. Related to wastewater quality tests performed by WAJ Central Labs for AGWA. Expenses on laboratory tests were available for the whole AGWA but not per cost center. Forecasting expenses on laboratory testing

is based on current expenses, increase in water supplies, percentage of number of samples tested compared to WHO Guidelines, and inflation in the cost of testing.

- Current Expenses (JD) * Percentage of Growth Rate in Water System Supplies (%) * Percentage of WHO Guidelines * Inflation Rate.

Other Expenses. Includes any other expenses that are not part of the above cost components.

- Current Other Expenses * Inflation Rate.

Debt Service G&A Expenses

According to WAJ decision, the debt service method has been used to account for the cost of new projects. This method requires that the interest expenses and principal yearly payments for each project are accounted for. Both interest and principal will be calculated for governmental loans, local loans, and international loans. Calculation is based on the value of loans, all interest rates applicable, and payments schedule.

- **Interest.** Includes interest on amounts borrowed, and commitment interest on amount reserved by lender for the project but not used.

- **Principal.** Principal payments include all payments made during the year toward the principal of the loan.

Wastewater Cost Center Worksheets

Below are the details of the expenses for each of the cost centers where they differ.

Assamra WSP

- Electricity. Consumption has been raised recently due to the installation of aerators. Future consumption will be fixed because of continuous operation of all aerators. A change in the number of aerators in the future will change the electricity consumption.

- Chemicals. Includes chlorine for disinfection and other chemicals for odor removal.

- Sludge Disposal. Required for every 350 MCM flow of wastewater.

Abu Nusair WWTP

Baqa'a WWTP

Wadi Esseir WWTP

- Sludge Disposal. Required for every 4 MCM flow of wastewater.

Fuhais WWTP

Naur WWTP

South Amman (East) WWTP

South Amman (West) WWTP

South Amman Land Application

Zarqa WWTP

Ain Ghazal Headworks

- Chemicals. For odor removal only.

West Zarqa Pump Station

Fuhais Pump Stations (1&2)

Existing Siphon

New Siphon

Amman Network

- Electricity. No expenses. Cost is zero.
- Chemicals. No expenses. Cost is zero.
- Sludge Disposal. No expenses. Cost is zero.

Network of Balqa to Baqa'a

Network of Balqa to Fuhais

West Zarqa Network

3.6 Links Between the Water and Wastewater Models

The AGWA-W and AGWA-WW models are linked together for the following reasons:

- To standardize global parameters;

- To link wastewater flow to growth in water use;
- To utilize AGWA staff salaries allocation between cost centers; and
- To allocate General and Administrative Expenses of AGWA and WAJ between water and wastewater.

The following links are available to support our objective:

- In the Wastewaster Income Statement worksheet (**WW IS**), common global parameters are linked to the water model (un-accounted for water, common costs, and inflation);
- In the Wastewater Flow worksheet (**WWFlow**), the model utilized the growth in water use and the average water use per subscriber from the water model;
- In the Performance Indicators worksheet (**Perf. Ind)**, the model utilized the salaries allocation and quantity of water used in the water balance;
- In the **Amman Network** worksheet, the model utilized the salaries allocation from the water model; and
- All data in the **G&A** worksheet are imported from the General and Administrative Expenses in the water model.

CHAPTER FOUR
MODEL USE AND MAINTENANCE

4.1 Use of the Model

Limitations of the Model

One obvious practical limitation of the model is its size. In trying to answer all possible questions, the model can easily get too big and cumbersome to be useful and there are limitations to the PC hardware used. While the design team has tried to incorporate a variety of analytical features, the focus has remained on the primary use of the model for financial planning and tariff analyses. This model is not intended to perform other types of specialty functions. It is not an accounting model that keeps detailed track of expenses or monthly cash flow. It is not an operations model that advises on daily operations or water quality blending. It is not an engineering design model that will identify project plans, specifications, and costs. Nor is it a life-cycle investment model that can more specifically weigh the monetized benefits and costs of a project investment.

However, the cost/tariff model can provide aggregate information that may be useful in further evaluation of these issues. It can provide a forecast of major expense categories by cost center and annual cash flow of the utility, information on the quantities and timing of supply needed, and with- and without-project cash flow of the utility that may be useful for a longer-term project investment analysis.

Development of Standard Planning Scenarios

It will likely be useful to the model operator and WAJ managers to have baseline or benchmark planning scenarios from which to evaluate the merit of other alternative actions. Typically two such scenarios are defined for these benchmarking purposes: the **no action** future, and the **most likely** future.

The **no action** future scenario usually involves a set of planning and policy assumptions whereby outside or external events in the world continue to occur (such as population growth, inflation), but there is no significant action by the internal organization (no new projects and no tariff increases). The purpose of this scenario is to indicate the real or implied cost of inaction, such as water shortages and financial deficits, and to help motivate decision-makers into timely and appropriate actions.

The **most likely** future scenario encompasses a set of planning and policy assumptions by the model operator and policy-makers on what they expect to happen in the future. This usually embodies continuance of recent trends in

population growth, the implementation of planned projects, tariff changes to meet revenue targets, and other expected actions.

From these two benchmark scenarios, the model operator and policy-maker can then examine alternative actions and other scenarios such as:

- What happens if the utility grows faster or slower?
- What happens if the population grows, but new connections to the system are delayed?
- What happens to system revenue if per capita water use patterns change?
- What happens to the wastewater system if water use increases?

The models' predicted outcome under these planning and policy variations can then be compared to the **no action** and **most likely** scenarios to see how changes in the underlying assumptions might affect the viability of no action or anticipated actions.

4.2 Model Modifications

Annual Updating and Modifications

At the beginning of each New Year, several annual updating changes will be required to keep the models current:

- The year just passed will now be a historical year instead of a forecast year. It will be important to keep this historical data as current and accurate as possible as this will be the source of useful trend information on which to base future calculations or guide future planning assumptions. The projected data should be replaced with historical data as available, and the cells of this new historical column of data should be colored gray to signify its historical character.

- To maintain the length of the future-planning horizon, a new future year should be specified at the end of the planning period. For the most part, this can be accomplished by selecting the column of the previous last year (say year 2007) and copying it to next blank column to the right (as the basis for the year 2008). Prior to copying the column the operator should <Page Down> through the sheet to make sure that the copying of the new column of formulas does not over-write any needed information.

Adding a Water Cost Center

If additional cost centers are required for the water model, the following steps should be followed:

- Insert new sheet in the proper place in the model;
- Copy one of the cost center sheets to the new cost center; and
- Zero all numbers for that cost center to allow for new data.

In the Water Balance the following information and formulas for the new cost center need to be added in the same order:

- Supply Needed to Meet Demand (add rows and formulas);
- Available Water Supplies (add rows and quantities);
- Specify Supplies Utilization Percentage (add rows and percentages);
- Supply Used (add rows and formulas);
- Specify Percentage Demand to be Met (add rows and percentages);
- Water Actually Supplied to Meet Demand (add rows and formulas); and
- Total Supplies Allocated (adjust formula).

Finally,

- Link the cost center to the water balance to reflect quantities in the cost calculation;
- Adjust the **WatExp** worksheet to accommodate the new cost center; and
- Adjust the **Cost Summary** worksheet to accommodate the new cost center.

Planning, Policy, Project Changes, and Sequence of Modifications

The AGWA-W and AGWA-WW models are not fully automatic. They require the intervention of the model operator or policy-maker to make new decisions given changes in the underlying conditions. For instance, providing for increased population growth without an increase in water supply may require the user to make new decisions about rationing available water supplies; or by allowing new water supplies to become available, the user may need to decide how much water to get from what source. In addition, any underlying changes that increase or decrease system costs may require a corresponding change in tariffs to reach desired revenue goals.

In general when confronted with a change in the underlying model parameters, the user should first ask if this change would affect water demands, water

supplies, system costs, and/or system revenues. He should think through the likely effects first, as this will likely be the best guide on what portions of the model need checking.

A good standard procedure for recalibrating the model after an underlying parameter is changed is:

- Check the factor most affected by the parameter and ask if it changed in the expected fashion. For instance, if the price per kWh of electricity increases 5%, did the predicted electricity costs for the subsequent year also increase in roughly the same amount? If not, check for formula errors or unexpected changes in other parameters affecting this variable. Then,

- Second, go to the water balance tables. Changes in factors affecting either water demand or supply will be reflected in a new water deficit or surplus situation. A change in either one of these conditions will require the user to make new decisions about demand rationing or supply allocation to rebalance demands that can be met with available supplies or to decide from which source supplies are obtained.

- Next, ask if the parameter change affects the functioning and cost at one of the cost centers identified in the model. If so, has the cost of that activity changed in rough accordance with expectations?

- Finally, ask if the parameter change necessitates a change in the tariffs to maintain revenue recovery at the desired target goal. If so, a change in tariffs may be required to finish the recalibration of the model.

Cautions on Changes

A good understanding of spreadsheets is one of the most important skills for the successful model operator. Some of these skills cannot be effectively taught, but are only understood and learned after an error has occurred. For this reason, it is always prudent to have recent backup copies of the model. The model is easy to edit for the skilled user and large portions of the model are not write-protected. Because of this, several cautions are warranted:

- Are the worksheets unintentionally grouped such that I am about to make changes to 10 sheets at once, instead of just the one sheet I want to revise?
- Have I thought through the effect of deleting or adding a row? Is there any other information to the right (off the view of the screen) that will be lost if I delete a row? Will I be changing the standard table structure on one sheet instead of all similar sheets if I add a row?
- Have I thought through the effect of deleting or adding a column? Are there reasons for such actions?

- Does the formula I am about to copy contain a relative or absolute cell reference that is desired in the copied formula, or alternatively, does it need a fixed reference?
- Before I save the file, do I want to Save As under an alternative file name to protect my original file?

Backup

The model requires annual update. Accordingly a backup should be prepared for the new version of the model and labeled properly as per procedure. Backup should be done for all scenarios prepared by the model operator and according to management decision.

The operator should prepare a new backup copy for all changes that are made during the year and for new scenarios requested by management.

Printing

Printouts of all worksheets of the model should be prepared annually for all scenarios, and more frequently as needed. These copies should be dated and labeled clearly to avoid any difficulties in utilizing the data such as using the wrong copy of the model for decisions.

ANNEX A
GLOSSARY

Absolute Cell Reference	Worksheet location of a cell or a range of cells containing values or data to use in a formula.
Adjustments to Revenue	Made on bills issued due to exemptions and expected metering errors.
Administrative or Commercial Losses	Percentage of water used that can not be billed due to metering error, illegal connections, or other administrative reasons.
Billing Collections	Amounts collected or expected to be collected from customers from current year billings.
Capital Cost	Cost of new projects, modifications, and additions to existing projects, plus the cost of additional fixed assets for the year.
Cost	Amount spent or accrued for the year to cover capital expenditures or to produce water.
Customer Water Demand	Quantity of water that customers are willing to buy and consume at the current tariff.
Expense	Amount spent or accrued for the year to cover current year expenses and the cost of producing water used by customers.
Fee	Amount charged to cover services in addition to water production and delivery.
Fixed Operating Expenses	Almost fixed for different flows of water, but vary from year to year, such as salaries and maintenance.
Global Parameter	Affects numerous items and multiple worksheets. Any change in this parameter will affect the results of the model.
Grouping (or selecting) Multiple Worksheets	Allows the user to adjust cost centers items or formulas in several worksheets at the same time.
Income	Includes revenues from all types and subscriber classes and other fees and charges.

Infiltration/Inflow (I/I)	Percentage increase in the flow of wastewater resulting from rains and sources of water other than the wastewater flow.
Local (or cost center) Parameter	Affects a single item or worksheet, such as average salaries or electricity for each cost center.
Links	Relation between two worksheets (or two models), where the data in one worksheet utilize information available in the other worksheet.
Net Income	Revenues from current year activities after deducting all expenses related to the current year.
Operating Expenses	Directly related to current year operations, such as electricity for pumping, chemicals, and salaries.
OMS Project	Operation Management Support Project
Per Capita Water Demand	Quantity of water one person is willing to buy and consume at the current tariff.
Physical Losses	Quantity of water lost during the year due to the leakage in the system.
Relative Cell Reference	Identifies a cell or a range of cells on a worksheet and tells Microsoft Excel where to look for the values or data use in a formula.
Return Flow	Percentage of wastewater that will return to the wastewater system from the total quantity of water consumed.
Revenue	Income accrued during a year from the sale of water to customers (retail, bulk, and tankers).
Supply Allocations	Allocation of available supplies to different governorates and to different subscriber classes.
Supply Availability	Quantity of water that is available or can be produced to meet demand.
Tariff	Rate specified for each usage block used for pricing the quantity of water billed.

Total Demand	Quantity of water demanded by all users of the system; amount customers are willing to buy and consume at the current tariff.
Unaccounted-for Water	Percentage of water produced in the system that can not be billed due to leakage, metering error, illegal connections, or other administrative reasons.
Variable Operating Expenses	Increase proportionally with the increase in the flow.
Wastewater Flow	Quantity of wastewater delivered to the wastewater system or to a certain wastewater facility.
WSP	Wastewater Stabilization Point
Water Pumped	Quantity of water produced from the source.
Water Use	Quantity of water used by water customers. Quantity of water pumped adjusted for leakage.
Water Use by Wastewater Subscribers	Quantity of water used by water customers who have a wastewater connection. Quantity of water pumped adjusted for leakage.
Workbook	File with one or more worksheets which organizes various kinds of related information.
Worksheet	Cells organized into columns and rows; a spreadsheet, always part of a workbook. The primary document for data management in Microsoft Excel.

ANNEX B
DATA INPUTS AND COLLECTION FORMS

Global Parameters Forms

Water Model - For the Year Ending _____

FORM WGP - 01 - Residential Customers

Usage Block Definition		Population Growth Rate (%)	Per Capita Daily Water Demand (lpcd)	Person Per Subscriber	Water Tariff (JD)

Information should be collected from WAJ Management.

FORM WGP - 02 - Institutional Customers

Usage Block Definition		Subscribers Growth Rate (%)	Demand Per Customer (m^3)	Water Tariff (JD)

Information should be collected from WAJ Management.

FORM WGP - 03 - Commercial Customers

Usage Block Definition		Subscribers Growth Rate (%)	Demand Per Customer (m^3)	Water Tariff (JD)

Information should be collected from WAJ Management.

FORM WGP - 04 - Industrial Customers

Usage Block Definition		Subscribers Growth Rate (%)	Demand Per Customer (m^3)	Water Tariff (JD)

Information should be collected from WAJ Management.

FORM WGP - 05 - Bulk Customers

Customer Name	Growth Rate (%)	Water Tariff (JD)
Tomato Factory from Deir Alla		
Salt from Zai		
Fuhais from Zai		
Madaba from Musitbeh		
Other		
Safout/Harbaj from Network		
Sahab Industrial State from Network		
Other		

Information should be collected from WAJ Management.

FORM WGP - 06 - Tankers Customers

Delivery Type	Growth Rate (%)	Water Tariff (JD)
WAJ Tankers		
Private Tankers & Government Depts.		
Army Tankers		

Information should be collected from WAJ Management.

FORM WGP- 07 - GLOBAL MODEL PARAMETERS AFFECTING REVENUE EFFICIENCY AND WATER FEES

1. UNACCOUNTED-FOR AND COLLECTION RATES

Item	Last Year (%)	Current Year (%)
UNACCOUNTED-FOR SUMMARY		
Physical Losses (Water Leakage)		
Amman Network		
Tomato Factory		
Salt		
Fuhais		
Madaba		
Other		
Safout/Harbaj		
Sahab Industrial State		
Other		
Administrative Losses**		
Total Amman Unaccounted-For*		
BILLING COLLECTION RATES		
Residential		
Institutional		
Commercial		
Industrial		
Bulk Customers		

*Does not include any unaccounted-for for delivery to bulk customers.
** Administrative losses include illegal connections, bad metering, no billing, etc.

2. SELECTED WATER FEE ACTIVITY

ACTIVITY	Last Year (%)	Current Year (%)
% of Subscribers That Re-connect		
% of Subscribers with Valid Complaints		
% of Subscribers with Leakage Detect.		
% of Subscribers with Damaged Meters		
% of Change in Other Fee Income		

Information should be collected from WAJ Management.

FORM WGP - 08 - GLOBAL PARAMETERS AFFECTING COMMON COSTS AND INFLATION

Item	**Last Year**	**Current Year**
Common Costs		
Electricity (JD/KWH)		
Fuel (JD/liter)		
Inflation Rate (%)		
Electricity/Fuels		
Salaries		
Chemicals		
Vehicles		
Testing		
Imported Materials		
General Other		

Information should be collected from WAJ Management.

FORM WGP - 09 - WATER FEE SCHEDULE (JD)

Item	**Last Year**	**Current Year**
Water Subscription Fees		
Standard Residential Meter		
Other Meters		
Connection Application Fees		
Re-connection Fees		
Complaints Fees		
Leakage Detection Fees		
Counter Fines		

Information should be collected from WAJ Management.

Water Demand Forms

Water Model - For the Year Ending _____

FORM WD - 01 - BULK WATER SUBSCRIBERS AND DEMAND

SUBSCRIBER	No.
Tomato Factory	
Salt	
Fuhais	
Madaba	
Other	
Safout/Harbaj	
Sahab Industrial State	
Other	
Total Subscribers	

Information should be collected from WAJ Management.

Water Balance Forms

Water Model - For the Year Ending _____

FORM WB - 01 - AVAILABLE WATER SUPPLIES

Source	Last Year	Current Year
Khaw		
Deir Alla		
Fuhais		
Qatreneh		
Disi		
Wala		
Qastal		
Swaqa		
Ain Ghazal – Ruseifeh		
Ain Ghazal – Tadj		
Ain Ghazal – Yajouz		
Nafaq – Muhajereen		
Nafaq - Ras Al-Ain		
Nafaq - Wadi Saqra		
Nafaq - Wadi Eseer		
Nafaq – Mowaqar		
Nafaq – Madoneh		
Nafaq – Qattar		
Erenbeh		
Musitbeh		
Other Source		
Total Available Supplies		

Information should be collected from WAJ Management.

FORM WB - 02 - WATER SUPPLIES UTILIZATION PERCENTAGES

Shared Resources with Amman	Last Year	Current Year
Khaw		
Other Khaw Customers		
Amman		
Total Khaw		
Deir Alla		
Tomato Factory		
Salt		
Fuhais		
Amman		
Total Deir Alla		
Fuhais		
Fuhais		
Amman		
Total Fuhais		
Wala		
Other Wala Customers		
Amman		
Total Wala		
Qatraneh		
Other Qatraneh Customers		
Amman		
Total Qatraneh		
Qastal		
Other Qastal Customers		
Amman		
Total Qastal		
Swaqa		

Other Swaqa Customers		
Amman		
Total Swaqa		
Musitbeh		
Other Musitbeh Customers		
Amman		
Total Musitbeh		
Disi		
Other Disi Customers		
Amman		
Total Disi		
Unique Resources to Amman		
Ain Ghazal – Ruseifeh		
Ain Ghazal – Tadj		
Ain Ghazal – Yajouz		
Nafaq – Muhajereen		
Nafaq - Ras Al-Ain		
Nafaq - Wadi Saqra		
Nafaq - Wadi Eseer		
Nafaq – Mowaqar		
Nafaq – Madoneh		
Nafaq – Qattar		
Erenbeh		
Other Source		
Total Supplies Allocated		

Information should be collected from WAJ Management.

FORM WB - 03 - WATER DEMAND MET, GIVEN SUPPLY CONDITIONS

Item	Last Year (%)	Current Year (%)
Amman Retail		
Residential		
Institutional		
Commercial		
Industrial		
Total - Amman Retail		
Bulk Demands		
Bulk Demands From Sources		
Tomato Factory from Deir Alla		
Salt from Zai		
Fuhais from Zai		
Madaba/Diban from Musitbeh		
Other		
Total Bulk Demands From Sources		
Bulk Demands From Network		
Safout/Harbaj from Network		
Sahab Industrial State from Network		
Other		
Total Bulk Demands From Network		

Total Bulk Demands		
Shared-Resource Demands		
Other Khaw Customers*		
Other Fuhais Customers*		
Other Wala Customers*		
Other Qatraneh Customers*		
Other Qastal Customers*		
Other Swaqa Customers*		
Other Musitbeh Customers*		
Other Disi Customers*		
Total Shared-Resource Demand		

This information should be fed by the operator until the deficit equals to zero; it should be done based on Management instructions.

Cost Centers Forms

Water Model - For the Year Ending _____

FORM WCS - 01 - FACILITY FORECAST PARAMETERS

Item	Last Year	Current Year
Variable Operating Costs		
External Water Sources		
Unit Cost (JD/m^3)		
Electricity		
Current Consumption (KWH/m^3)		
Generator Fuel Consumption Rate (liter/m^3)		
Chemicals Cost (JD/MCM)		
Fixed Operating Costs		
Salaries & Wages		
Current Staff		
Management Changes in Staff		
Average Cost per Staff (JD)		
Social Security Payments		
% of SS to Salaries & Wages		
Spare Parts & Maintenance		
Current Maintenance (Mil JD)		
Change in maintenance (Mil JD)		
Vehicles Expenses		
Utilities Expense		
Average Cost per Staff		
Generator Fuel – Standby Testing		
Quantity of Fuel (liter)		
Other Expenses		

Historical data for Sources within the AGWA service area can be acquired from AGWA, and most of the information required can be acquired from the new accounting system implemented by the OMS Project.

New Projects Forms

Water Model - For the Year Ending _____

FORM WCC - 01 - OPERATIONAL AND FINANCIAL PARAMETERS FOR NEW PROJECTS (Capital Cost)

1. Operational Parameters

Phase 1-A		**Phase 1-B**	
Operational Start Date		Operational Start Date	
Change in Power (KWH/m^3)		Change in Power (KWH/m^3)	
Change in Staffing Level		Change in Staffing Level	
Change in Maintenance		Change in Maintenance	
Phase 1-C		**Phase 1-D**	
Operational Start Date		Operational Start Date	
Change in Power (KWH/m^3)		Change in Power (KWH/m^3)	
Change in Staffing Level		Change in Staffing Level	
Change in Maintenance		Change in Maintenance	

2. Financial Parameters

Project Funding (mill. JD)	Mil JD	Ex. Rate	FC	JD		Financing Terms	
Project Costs						Debt Service Start	
Less Cash Transfer						Local Interest Rate	
Less Grant Contribution						Local Commitment Rate	
Less Govt. Loans						Local Loan Term (yrs.)	
Less Local Loans						Govt. Interest Rate	
Less Int'l Loans						Govt. Commitment Rate	
						Govt. Loan Term (yrs.)	
						Int'l Interest Rate	
						Int'l Commitment Rate	
						Int'l Loan Term (yrs.)	

3. Details of Loans Transaction

Item/Period	Last Year	Current Year
Debt Service (mill. JD)		
Govt. Loan Borrowed During the Year	0.000	0.000
Governmental Loan Principle	0.000	0.000
Local Loan Borrowed During the Year	0.000	0.000
Local Loan Principle	0.000	0.000
Int'l Loan Borrowed During the Year	0.000	0.000
International Loan Principle	0.000	0.000

The information for this schedule should be collected from the Loans Department. The financial and operational parameters should be fed at the beginning, and then updated in case of any changes on estimates. The details of loans transactions should be prepared on a yearly basis.

This model can be used for both water and wastewater cost centers.

General & Administrative Forms

Water Model - For the Year Ending _____

FORM WGA - 01 - GENERAL & ADMINISTRATIVE EXPENSES

FORECAST PARAMETERS

Item	Last Year	Current Year
Salaries & Wages		
Average Cost per Staff (JD)		
Number of Staff		
Social Security Payments		
% of Social Security to Sal. & Wages		
Utilities Expense		
Cost per Staff per year (JD)		
Offices Rent		
Airspace		
Stationary & Supplies		
Cost per Staff per year (JD)		
Vehicles Expenses		
Building Maintenance		
Facilities Maintenance		
Cleaning Expenses		
Laboratory Testing		
% of WHO Testing Guidelines		
Inflation rate for Testing		
Other Expenses		

Historical data for WAJ General and Administrative Expenses can be acquired from WAJ's Financial Department, and AGWA General and Administrative Expenses can be acquired from the new accounting system implemented by the OMS Project in AGWA. Except for laboratory testing as it is applicable only for AGWA and information should be obtained from management.

Salaries Allocation Forms

Water Model - For the Year Ending _____

FORM WGA - 01 - NUMBER OF STAFF FOR SALARIES ALLOCATION FOR BOTH WATER & WASTEWATER

Item	Last Year	Current Year
Number of Staff		
Administration & Finance		
Design & Tech.		
Connections		
Collection, Inspection, Invoicing, Meters		
South Amman		
Tankers		
Sewerage		

This is applicable for AGWA only to allocate salaries into different cost centers, and all information can be acquired from AGWA.

Global Parameters Forms

Wastewater Model - For the Year Ending _____

FORM WWGP - 01 - Residential Customers

Usage Block Definition		Water Tariff (JD)

Information should be collected from WAJ Management.

FORM WWGP - 02 - Institutional Customers

Usage Block Definition		Water Tariff (JD)

Information should be collected from WAJ Management.

FORM WWGP - 03 - Commercial Customers

Usage Block Definition		Water Tariff (JD)

Information should be collected from WAJ Management.

FORM WWGP - 04 - Industrial Customers

Usage Block Definition		Water Tariff (JD)

Information should be collected from WAJ Management.

FORM WWGP - 05 - WATER FEE SCHEDULE (JD)

Item	Last Year	Current Year
Sewerage Connection Fees		
Sewerage Tankers Income		

Information should be collected from WAJ Management.

Wastewater Flow Forms

Wastewater Model - For the Year Ending _____

FORM WWF - 01 - Facilities Details

Item	Last Year	Current Year
General		
Return Flow Percentage		
Change in Infiltration/Inflow factor (%)		
Number of New Subscribers		
Assamra WWTP		
Zarqa WWTP		
Abu Nusair WWTP		
Baqa'a WWTP		
Wadi Esseir WWTP		
Fuhais WWTP		
Naur WWTP		
South Amman (East) WWTP		
South Amman (West) WWTP		
South Amman Land Application		
From Amman to Ain Ghazal		
From Amman to Zarqa West		
From Zarqa Wets Pump Station to Siphon		
From Amman (Sweileh) to Baqa'a WWTP		
From Balqa to Wadi Esseir network		
From Amman (Princes Haya Suburb) to Fuhais		
From Fuhais Pimp Station 2 to Fuhais WWTP		

This information should be collected from wastewater department.

Wastewater Model - For the Year Ending _____

FORM WWR - 01 - NUMBER OF SEWERAGE TANKS TRIPS

Item	Last Year	Current Year
Number of Sewerage Tanks Trips		

This information can be collected from AGWA.

Wastewater Model - For the Year Ending _____

FORM WWCS - 01 - FACILITY FORECAST PARAMETERS

Item	Last Year	Current Year
Variable Operating Costs		
Use of Others Facilities		
Cost (JD/m^3)		
Quantity of WW (MCM)		
Electricity		
Current Cost KWH/m^3		
Chemicals Cost (JD/MCM)		
Sludge & Screenings Disposal (JD/MCM)		
Fixed Operating Costs		
Salaries & Wages		
Current Staff		
Management Changes in Staff		
Average Cost per Staff (JD)		
Social Security Payments		
% of SS to Salaries & Wages		
Spare Parts & Maintenance		
Vehicles Expenses		
Spare Parts & Maintenance		
Change in maintenance %		
Utilities Expense		
Average Cost per Staff		
Other Expenses		

Historical data for sources within AGWA service area can be obtained from AGWA. Most of the required information can be obtained from the new accounting system implemented by the OMS Project.